THE

Practical Teacher

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'Knowledge is proud that he has learned so much,
Wisdom is humble that he knows no more.'—COWPER.

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Health at School.

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VIII.—VENTILATION—*continued.*

WARMING AND LIGHTING.

IT will be seen from the foregoing that crowds are manufacturers of foul air, as well as of the draughts which are set up for its removal after its manufacture. Draughts will be best prevented by warming the air, which must and will get into the place which foul air has contaminated, when that contamination is accompanied by a rise of temperature. It is shown that the best way to warm that air is by means of jets of gas so arranged as not themselves to be contaminators of the warmed air. There are many advantage in the use of gas. If judiciously adapted it produces warmth at the same time that it is able to remove the foul air manufactured by the crowd. It obviates the mischief which arises from the concentration of heat in one place, such as happens when heating is effected by open fireplaces. The greatest advantage attending its use is that it can be almost infinitesimally divided. It obviates dirt and dust; coal bunks are not required, there are no smoky chimneys, and, as a consequence, when its use becomes more general for such purposes there will be a considerable diminution of intensity in those dense fogs which now oppress large cities wherever coal is consumed in the wasteful way which is the custom at the present day. The use of gas for lighting purposes will gradually diminish, but its use for heating and ventilation is only commencing, a gas of lower illuminating but greater heating power may be produced at a less cost than that of the gas which is now in use, and when it is available it will be found to be by far the cheapest way of warming all public buildings in places where gas is in general use. Even when 3s. 6d. per 1000 feet has to be paid for it it is cheaper than coal, all things being taken into consideration, that is if the arrangements are carried out in a proper manner. Fortunately the necessities of a period always bring forth the help which is wanted, and this is the case here, for the General Gas Heating and Lighting Apparatus Company, as well as other firms, provides every kind of help which is wanted in connection with warming and ventilation. There are very few places in which gas is not now available, and there ought to be no difficulty in its adaptation, except that which naturally belongs to a first expenditure of capital, in order to get these matters properly arranged. No system of ventilation is satisfactory which allows the temperature of the room to rise above 60° in cold weather, or which does not allow the air to be renewed during the day, very many times over. A school attendance without exposure to draughts of cold moist air must be a necessary part of the performance. I use the term 'cold moist air' because it is the presence of moisture which seriously adds to the evil of draught. Its opposite of dry hot air is similarly hurtful, and must be equally avoided. These conditions having been laid down it is necessary that there should be an intelligent supervision of the means in use, and that the laws which regulate these means should be understood by the attendant who is in charge of the school; otherwise, as the conditions outside are constantly altering, frequently in a direction antagonistic to those within, if the latter are not altered to correspond with those changes there will be failure in the principle adopted, and a resulting evil, for there is no plan of ventilation which will be always self-acting and equal to all changes. I have said that the method of ventilation is intimately associated with that of lighting. The part of my subject connected with light will be dealt with more fully in the section which will be devoted to eyesight, but I may now remark that the direction in which the light falls upon the student's desk or book is of great importance in connection with correct teaching. A combination of lights throw double shadows. The worst light is that which comes directly from the front of the scholar. It is not good for him to sit in a window facing a bright light. The light should come to the scholar from a point on either side, or above the shoulder, or from behind him; that from the left side is best. It is not beneficial to have the light entering from both sides of the room unless it is a very large one. Those lights directly to the rear are bad, because they throw the shadow which is produced by the scholar upon his work. It is necessary also that the light should not be directly in front of the teacher. That position of it positively decreases his power of overlooking the pupils,

and may at the same time be absolutely annoying to himself. It is necessary to arrange the work of the school upon the lines indicated by these suggestions. Abundant light is absolutely necessary, and the more fully it can be arranged so as to strike the desk at a considerable angle the better for the pupils. The higher the windows rise, therefore, in the wall of the room, the better also for lighting as well as for ventilating purposes. Windows that are too low down are not of so much use. The lower panes are of no service for lighting, though they are useful for ventilation when the windows are made to open both top and bottom. A school should have at least one-fifth of its wall space devoted to lighting by the sun's rays, and if it amounts to one-fourth so much the better for both health and education. A so-called dim religious light is opposed to health, and tends to develop the hysterical state so much admired and so much promoted by some schools of religious thought. It cannot assist to bring out a healthy mind, and, as a consequence, it must impede the healthy action of brain matter. Light goes with knowledge and mental power. A dim light probably impedes the formation of the habit of private judgment, and assists the pupil to follow the lead of the teacher more closely; but it does not tend to health. That which does not produce a perfect state of bodily health, or impedes its growth, cannot be good for any body of people, and this applies to children much more than to adults. I object, therefore, upon points connected with Hygiene to a dim religious light. Light must be diffused as equally as possible all through the room: dark corners and dark ends should be got rid of by opening windows in the blank walls, or putting in skylights, if the walls are not outside walls. The direct light from a skylight is not so beneficial as an oblique light. Those schools which are to be used for drawing classes will generally require that the light should come in from above as well as at the sides of the room. The more openings which can be made to communicate with the outer air the better for ventilating as well as for lighting purposes. It will be found that a domed roof is better than a flat roof for both objects, and when skylights are obliged to be flat they must be protected by proper blinds.

It will be right to give a few instructions upon the method of lighting by artificial means for those schoolrooms in which evening classes are held. The time for the use of the electric light in our schools has not quite arrived. The division of the electric light at present is too expensive to allow of its introduction into the school and class-room; but the day is not far distant when the change will be made, to the infinite advantage of the general health of the people. If gas is used for lighting purposes in the way that it is at present, it so completely deteriorates the air of the room as to quickly take out all the healthy vital properties which belong to it. Ozone is rapidly removed, and the oxidizing power of the air very much diminished thereby. That is when gas is used with an ordinary burner. If it be enclosed in glass globes, such as are made by Benham, where the products of combustion are compelled to leave the room at once by a proper conduit, the evil is obviated. The conduit passes from the globe into one of the flues, or directly out of doors into the open air; whilst the gas itself is supplied with air by another tube, which draws its supply from some available source. The evil of gas is also, to some extent, obviated by the ordinary sun-burner, which is fixed a short distance below the roof, with a chimney directly above it to carry off the foul air which results from the combustion of the gas; and with it also a portion of the heat is made to escape. The difficulty which belongs to the sun-burner, viz., its concentration, is overcome if gas is used with closed globes in those parts of the room which the light from a sun-burner does not reach. Pendant stars, freely multiplied at a considerable height, are good means of lighting in lofty schoolrooms, provided ventilation is quite perfect. No method, however, except the electric light, is satisfactory, unless there is an increased power of ventilation, especially as regards the entrance of fresh air, wherever the gas is lighted. Rooms are generally provided with conditions of ventilation which may be satisfactory when the room is moderately filled in a bright cool afternoon; but let it be filled full and the gas lighted when the lights are simply wall burners or standards, and then, in a very short time, the air of the room becomes absolutely pestiferous. It is probable that an immense injury is done to the public by the present method of lighting this class of room in the manner indicated. To remove this great evil all the products of gas combustion must be carried out of doors as quickly as possible without the possibility of their being breathed by the children. It is necessary for all the windows to be fitted with roller blinds, so that the light of the sun may be diminished when necessary, and the direct rays kept from interfering with each other, and producing a cross light. When gas is used in a school during the teaching time, each lamp should be provided with a shade, by means of which the intensity of the light may be broken. The shade should not be so opaque as to cast a shadow upon the upper part of the room; but it should be just enough to allow the light to be looked at without inconvenience. Ground-glass shades are useful for this purpose. These are important points which will be referred to in another part of my subject—viz., eyesight. There is much difficulty from the ordinary sun-burner, so that it is all but inadmissable for teaching purposes in common schools. If used at all, it should have the bright light prevented from falling directly upon the desk of the pupil by properly managed reflectors.

It will be seen that I make no mention of hot water for heating purposes. Hot-water pipes are costly; the apparatus is liable to go wrong at the most unfortunate period, and cannot be easily put right again, whilst there are other dangers attending its use, which make it unwise economy in school houses; and hot-air flues are even worse still. I like the appearance of an open fireplace; we are so accustomed to its presence that a room does not seem to be furnished without one; but I object to the dust which an ordinary fire produces, and, wherever possible, I would advise that the use of coal be discontinued, and some form of gas be used, if gas is reasonable in price—that is, not more than 3s. per 1000 feet. If it is too expensive to be used in this way, or the gas is not available for the purpose as suggested with gas jets and ventilators, then some form of closed stove on the slow combustion principle manufactured of fire clay should be used.

I can confidently refer to Mr. Doulton's slow combustion stoves as admirably fitted to economise fuel, to diffuse warmth, and save trouble, as well as annual

expense in housekeeping. They may be lighted over night in cold weather, and will keep the place warm for the following day, or if lighted early in the morning in more moderate seasons, will warm the room most thoroughly in a few hours, but, being slow burners, they do not get up heat very rapidly, and it would not do to light them only just before the assembling of the school, at least in very cold weather. The quantity of fuel which they consume is, however, so small that it is advisable and not expensive to have them lighted over night in all severe seasons. The temperature of a school-house or class-room should not be allowed to fall below 45° at any time, night or day, whilst the school is in session; if the walls get quite cold, there is a difficulty in warming them again, whilst if the room is well ventilated immediately after the class has separated, and if it is cleaned up at once, as it ought to be, and not left until the morning, in cold seasons, the stove lighted and allowed to burn all night, the room will never get cold at all, if Doulton's stoves are used or two or three of the gas jets kept alight. The walls of the room do not get cold, and the children are comfortable as soon as they enter the room on a cold winter morning, instead, as is too often now the case, shivering and quite unable to take in the teacher's meaning until the warmth from their own bodies has warmed up the place. In the meantime the radiation from the cold walls upon those children who sit near to them may have inflicted very serious injury.

I would urge managers of schools to recollect this, and not allow the walls to get cold. Ventilate the room well immediately after the class is concluded; get rid of all foul air before it has had time to be absorbed by the walls. The epithelial cells and other debris left in the place should be removed before they can be deposited in chinks and crevices, which are sure to be present. Have the floors swept up as soon as the class is over, and then the place dusted. Then close up for the night, lighting the warming apparatus if the thermometer is likely to go down below 39·5; there will then be a healthy room for the children to assemble in in the morning, comfortable to their feelings, assisting them in their work, and making their control and management all the more easy to the teacher and his staff. The first half hour is not then lost by the children in their efforts to get warm and to escape from the depressing effect of cold walls, which abstract warmth from the little scholars, and very often do them a serious injury. There is another part connected with lighting, but often neglected in all classes of schools. The windows are seldom cleaned. This is a duty which should be regularly performed. The deposit of filth from the breath is considerable upon a sheet of cold glass. If it be allowed to remain there and to dry up, it may be a source of mischief; it assists to depreciate the vital properties of the atmosphere, because it adds to the matter to be oxidized. It is not a large addition, but there is enough to propagate infectious disease, if germs of infectious matter should be deposited on the glass. A well-conducted school requires that the windows should be cleaned as regularly as the floors are scrubbed and the walls dusted down. It is a duty that should be placed upon somebody to see that it is done, for it is attention to minor matters which more certainly ensures that greater ones shall not be omitted.

Anecdotal Natural History.

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No. IX.—THE CETACEA, OR WHALES.

THE mere fact that the Whales are exclusively inhabitants of the water, is usually held to be a sufficient proof that they should be included among the fishes. In fact, it is generally considered that all sub-aquatic creatures, be they mammals, fish, crustacea, or radiates, may be included under the one comprehensive title.

As far as the whales are concerned, there is certainly some ground for the idea. Their habits and mode of life, their food, and their very form, so closely resemble those of the fishes that we can scarcely wonder if these animals are popularly supposed to form part of that group. We have only to look a little more closely into their structure, however, to find that they have nothing in common with fishes.

An examination of their mode of breathing is alone sufficient to point out the true position of the whales in the animal kingdom.

It is well known that all the fishes respire by means of gills, by the agency of which the necessary oxygen is extracted from the water which they inhabit. But the whales, like all other mammals, are obliged to breathe atmospheric air by means of lungs, for which purpose they are compelled to rise to the surface of the water. Were they prevented from doing so, they would be drowned just as would any other mammal under similar circumstances. The mode of life of the whales, however, differs completely from that of other mammalia, the breathing apparatus being modified in such a manner as to allow them to remain beneath the water for a considerable space of time. This structure we shall presently examine in greater detail.

As the method of respiration effectually disproves the general notion that whales should be ranked among the fishes, there is little difficulty in placing them in their true position. The structure of the heart, which possesses two auricles and two ventricles, whereas the fishes only possess one of each, and the fact that the young are nurtured by the mother's milk, are proofs amply sufficient to determine their true situation to be among the mammalia.

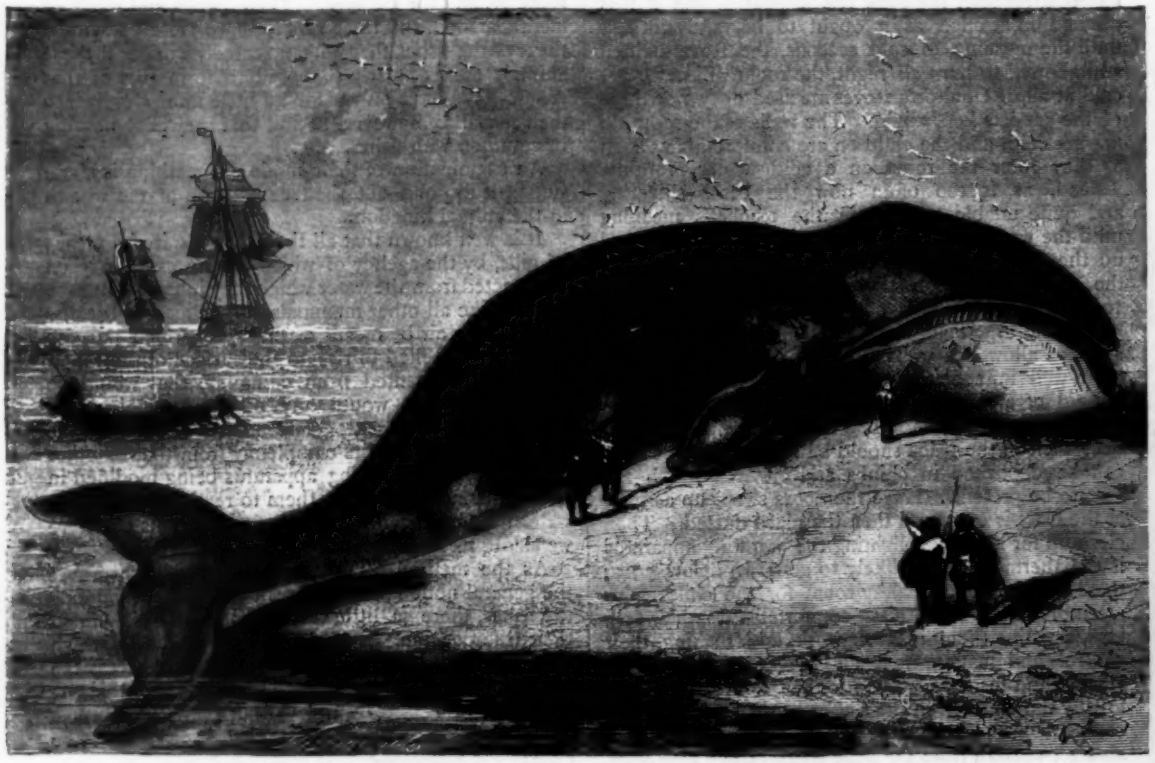
In few other animals do we find the structure more curiously modified to suit the conditions of existence than is the case with the whales. Passing the whole of their life in the water, their form, like that of the fish, is that best adapted for passing through their native element; the organs of locomotion, however, are of a different nature.

The fore-limbs, until stripped of their covering, closely resemble the fins of a fish. They are, however, of little use in forcing the animal through the water, their chief duty lying in preserving the equilibrium of the body and in clasping their young. The hinder limbs are not developed, being visible merely as small and imperfect bones when the skeleton is examined. In fact, they can scarcely be said to exist at all, and the very pelvis is only a slight rudimentary process, not attached to the spine.

The great organ of locomotion is found in the tail, which is set transversely with the body, and is usually

of very great comparative size. In a whale of ordinary dimensions, the tail, though only a few feet long, would measure in breadth almost one-fourth of the whole length of the body. Even these dimensions, large as they are, are sometimes exceeded; a whale captured a year or two since, and which was only sixty-five feet in length, measured no less than twenty-seven feet in the breadth of the tail.

The muscular power of this organ is simply enormous, the animal being enabled by its aid to leap clear out of the water to a height of several feet, a movement usually known as 'breaching.' The chief danger in whaling lies in the blows of the animal's tail, any one of which is sufficient to dash the boat and its occupants to fragments.



Right Whale.

Although in almost every pictorial representation of the whale the eye forms a very conspicuous object, it is in reality extremely small in comparison with the size of the animal, sight being of little use in taking the prey. The ear, too, is exceedingly minute, and for a very good reason.

It will be remembered, of course, that water which is much more dense than air, is a proportionately excellent conductor of sound. If a man submerges his head he can hear the beat of oars upon the surface, while the boat to which they belong is a mile or more distant.

Again, if a swimmer dives beneath the water, and a heavy blow be struck upon its surface above him, he not only hears the sound, but is almost stunned by the shock. So we can easily see that if the ear of the whale were proportioned in size to the dimensions of its owner, the animal would inevitably be killed by the shock caused from the first blow of its own tail.

In point of fact, the external ear of the whale is so small that it will scarcely admit a crowquill.

Here we are met by another problem.

Even when the whale lies on the surface the ear is under water, and can only hear sounds that are transmitted through the water. How, then, is the whale to hear sounds that are made above the surface and are transmitted through the air? The difficulty seems insuperable, but is overcome in the simplest manner imaginable. Let us see what is the structure of the ear in mammalia, taking our own as an example.

First, there is an aperture for the admission of air. At a variable depth in this aperture, a very elastic membrane, called the 'tympanum,' or drum, is stretched tightly across it, and is acted upon by any vibrations of air which are rapid and regular enough to become sounds.

On the other side of the drum is a set of bones, called, from their appearance and office, the hammer, anvil, and stirrup. These take the vibrations of the drum, and transmit them to the nerves of hearing, through which they pass to the brain. I may incidentally mention that the modern telephone is nothing but a rude imitation of the structure of the ear.

The tube does not end at the drum, but passes on, though very much reduced in size, to the back of the throat. If this secondary tube (called the Eustachian tube) be stopped, deafness results, because the vibrations of the drum are checked.

Now, in the whale the size of the two tubes is reversed. The external tube is very small, but the Eustachian tube is very large, and passes into the nostrils, or 'blow-hole.' The aperture of this blow-hole is always above water when the whale floats on the surface, so that the vibrations of the air can pass through it to the tympanum. Thus the whale hears through the blow-hole any sounds which are caused by the vibration of air, and through the external tube those sounds which are caused by the vibration of water.

I mentioned that the blow-hole has only a partial right to the name of nostril. It performs only one duty of a nostril, *i.e.*, that of admitting air to the lungs, and is not in any way an organ of scent. In fact, the sense of smell is absolutely wanting in the whale tribe, the entire system of olfactory nerves being absent.

No water can pass down the blow-hole, a simple and very effective valve being so arranged that it closes the aperture by the mere pressure of the water above it.

The whales being warm-blooded animals, some provision must necessarily be made for retaining the vital heat of their bodies in the conditions under which their lives are passed. Yet to all outward appearance, this seems to have been entirely neglected, the smooth and polished skin being apparently the very worst medium which could possibly have been chosen.

A glance beneath the surface, however, tells a different tale. We find that immediately beneath the skin is a layer of coils of fat, some twelve to eighteen or more inches in thickness, which is enclosed in tough, membranous cells. This substance, commonly known as 'blubber,' serves a double purpose, the non-conducting fat retaining the heat of the body, while the thick elastic mass resists the enormous pressure of the water at the vast depths to which the animal descends.

We now come to the remarkable modification of the breathing apparatus which allows the whale to remain beneath the water for a considerable space of time without rising to the surface in order to obtain a fresh supply of air.

As is the case with all warm-blooded animals, respiration in some form or other must be continually kept up. The blood must be constantly supplied with oxygen or life cannot be preserved.

With the whale, however, the necessity for constant respiration would entirely prevent it from pursuing its search for prey at the depths to which it descends, and would oblige it to face death in one of two forms —starvation or suffocation.

Cachalot.

A most wonderful structure is therefore provided, which enables the animal to aërate a supplementary stock of blood, which can be introduced into the circulatory system as occasion requires, taking the place of the exhausted fluid, and doing away with the necessity for constant respiration. This is managed as follows :—

When the whale ascends to the surface of the water in order to breathe, it makes a succession of inhalations, generally some forty or fifty in number, which are usually termed the spoutings, on account of the shower of water mixed with hot breath, which is thrown up into the air to the height of eighteen or twenty feet. During this operation, the whole of the blood is

thoroughly ærated, not only that in the circulatory system, but also the reserve supply, which is stored away in a vast mass of auxiliary blood-vessels which line the interior of the chest. These vessels contain a sufficient stock of the purified blood to sustain the animal for a considerable time without obtaining a fresh supply of air, and it is by no means unusual for a whale to disappear beneath the water for upwards of half-an-hour without rising to replenish its stock.

Were it not for the knowledge of this habit the difficulties of whaling would be greatly increased; as it is, however, the huge animal is slain with comparatively little trouble.

When a whale is seen, a boat puts off and makes for the spot as speedily as possible.

As soon as the boat approaches within a short distance, a harpoon—a spear with a barbed head, to the end of which is attached a coil of rope—is flung at the animal.

The frightened whale instantly dives beneath the surface, carrying the harpoon with it, the rope being uncoiled from the boat as rapidly as possible. For half an hour or so, the animal remains beneath the surface, but is at length obliged to rise in order to procure a fresh supply of air. No sooner does it appear, and begin its spouting, than the boat approaches, and again drives it below before the operation is completed.

Not having been able to aërate the whole of the blood, it cannot remain so long beneath the surface, and is soon obliged to again rise in search of air. Again it is driven below, and so on until the animal is so weakened from want of air that the pursuers can come to close quarters.

The depth to which a whale will descend when pursued is simply astonishing. On one occasion the animal took down with it more than one thousand fathoms of rope, or considerably over a mile, and yet was enabled to bear the tremendous weight of the rope, and also to drag the boat with its pursuers rapidly through the water.

It appears strange that so comparatively insignificant a weapon as the harpoon should prove so deadly to an animal of such enormous dimensions. But the animal does not lose its life on account of the very slight wound produced by the harpoon.

The real instrument of death is the spear, which has a small and very sharp blade and a very long handle. When the whale is quite exhausted by fatigue, the spear is thrust into the vital organs, and in spite of its size the animal easily succumbs.

Formerly, the harpoon was always thrown by hand. It is now mostly shot from a gun, and, of course, can penetrate more deeply than the hand-thrown weapon.

To mankind, whether in a civilized or a savage condition, the whale is of inestimable value. From the blubber and other parts of the body we obtain the valuable oil, which in many countries is almost a necessity of life; the so-called 'whalebone,' and the bones themselves are of considerable value; and, by the dwellers of the polar regions, almost every part of the body is used as food, the skin, and, more particularly, certain parts of the gums, being considered as very great dainties.

The curious substance popularly known as 'whalebone' deserves a few words.

To the title of 'bone' it has no claims whatever, its structure being analogous to that of hair, feathers, scales, and teeth, which are merely the same substance under different forms. It is found in the jaws, lying in thin flat plates of various breadth, and from ten to twelve feet in length. These do not spring from the gums themselves, but from a curious vascular formation resting upon them. Each plate is split at the extremity into a number of hair-like filaments.

In a certain sense, the whalebone takes the place of the teeth, inasmuch as it captures the prey, although it is not used for mastication, which, from the nature of the food, is rendered unnecessary. Its use is as follows.

Those species of whales which are provided with the 'baleen,' or whalebone, prey upon creatures of very minute size, such as small shrimps, crabs, and lobsters, medusæ, etc., which are generally found in large shoals. Its chief food consists of a small mollusc called the Clio. Opening its huge jaws to the widest extent, the whale drives rapidly through the shoal, thus filling the mouth with the little creatures; the jaws are then closed, and the contained water is driven out through the interstices of the whalebone. This, however, completely prevents the escape of the prey, which can then be swallowed at leisure.

Having now glanced at the principal characteristics of the whales as a family, we will take each of the more important members in turn, and devote a short space to their habits and peculiarities.

The first in order is the Greenland Whale *(Balæna mysticetus)*, or, as it is often termed, the Right Whale. This whale is an inhabitant of the seas bordering upon the northern polar regions, where, in spite of the annual slaughter, it is still to be found in considerable numbers.

The Greenland whale, although of great size, is by no means equal to the huge rorqual in its dimensions. Its average length is from fifty-five to sixty feet. The head is extremely large, occupying rather more than one-third of the whole bulk.

The colour of this whale is a deep velvety black upon the upper parts of the body, and greyish white upon the under surface. It is one of the most useful of all the whales to mankind, the baleen, or whalebone, being long and of fine quality, and the oil rich, and found in great quantity. Even the very bones teem with the oil, the jawbones especially producing a considerable amount.

It is believed that one cub only is produced at a birth in the case of the Greenland whale. For the first few month of its life the baleen is not developed, and the young whale is obliged to depend for the whole of its nourishment upon its mother, who never leaves it until it is old enough to forage for itself.

The Rorqual *(Physalus boops)* is the largest of the whale tribe, sometimes attaining to the extraordinary length of one hundred feet, or even more. In spite of its huge size, it is of comparatively little value, the oil obtained from the body being very scanty, and the whalebone short and of very inferior quality. The animal is therefore seldom molested except by inexperienced sailors who are unable to distinguish it from the Greenland species.

The food of the rorqual consists not only of the minute creatures before mentioned, but also of the larger fish, such as the cod, etc. The nature of the food being so different, the gullet of this whale is of much greater size than in the Greenland whale, in which animal it barely exceeds two inches in diameter. There is a popular saying among seamen that the

Greenland whale can swim a jolly-boat and crew in its mouth, and yet be choked with a herring.

In search of its prey, the rorqual often follows the shoals of fish from place to place, and occasionally takes up its quarters upon the borders of the fisheries, to which it causes considerable damage. In such a case it often happens that, pursuing its wished-for prey rather too rashly, it becomes stranded upon the beach, where it is utterly helpless, and is easily slain. A year seldom passes, even in our own country, without a rorqual or two being stranded upon the shores.

The rorqual may be distinguished from the Greenland whale by its dark-greyish hue, by its more slender form, and by the fact of its possessing a dorsal fin. The skin lies in deep longitudinal folds along the under parts of the body, for which reason the name 'rorqual' was given to it, that title being derived from a Norwegian word signifying a 'whale with folds.'

The Spermaceti Whale *(Catodon macrocephalus)*, or Cachalot, is of great value to mankind, both on account of the oil procured from the blubber, which is of a very fine quality, and also of the substance known as spermaceti, which is found in considerable quantities.

This whale differs in several important points from the two preceding species.

The head is extremely large, occupying nearly a third of the entire length, whence the name *macrocephalus—i.e.*, 'large-headed'—is derived. The snout is abruptly squared off, and the blow-hole is placed upon the fore part of the head. The jaws are not provided with the baleen, or whalebone, but are furnished instead with a number of formidable teeth, set in the lower jaw, and fitting into corresponding cavities in the upper one. The upper jaw has merely a short row upon each side.

Although to us these teeth are of no particular value, they are held in the greatest esteem by certain savage tribes. On more than one occasion a war has been waged by one chief upon another, merely for the possession of a single whale's tooth.

The cachalot attains to a considerable size, its average length being from seventy to seventy-five feet in length.

The skull, which is elongated and narrow, does not occupy more than one-half of the space assigned to the head, the upper portion being composed of tendinous cells. In two great cavities in this mass is contained the spermaceti, which is found in a fluid, oily condition, and is literally baled out by means of buckets, a hole being cut in the upper part of the head, and the spermaceti extracted just as is water from a well.

The oil expressed from the blubber is of a very fine quality, and is obtained in considerable quantities, a cachalot of ordinary size yielding about one hundred barrels, as well as twenty-four barrels, or thereabouts, of the spermaceti.

This whale is able to remain beneath the water for a much longer period than the previously described species, an hour sometimes elapsing before it is obliged to return to the surface. The 'spoutings' are from sixty to seventy in number, and occupy about ten minutes. It is a curious fact that the number of spoutings is always exactly the same in the same individual.

As regards the locality in which it is found the cachalot is a rather ubiquitous creature, inhabiting all parts of the ocean, excepting those in the neighbourhood of the polar regions. It is an occasional visitor to our shores, but is less often seen there than is the case with the Greenland species.

(To be continued.)

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Practical Lessons on Insect Life.

BY THEODORE WOOD, M.E.S.,

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No. VII.—THE DERMAPTERA, OR EARWIGS, AND THE ORTHOPTERA.

PART I.

UNTIL of late years, the true situation of the earwigs in the insect world was a matter of considerable doubt. Some entomologists considered that they should be ranked among the beetles; others that they formed a part of the *Orthoptera* (or Cockroaches, etc.) while others again held them to belong to a separate order, which they entitled *Dermaptera*, a word signifying 'skin-winged,' and which was applied to them on account of the peculiar structure of the elytra.

The first of these theories, viz., that the earwigs constituted one of the families of the *coleoptera*, was easily disproved as soon as the life-history of these insects was enquired into; for it was found that the pupæ, instead of passing through that stage of their development in a state of quiescence, as is the case with the beetles, were fully as active as the perfect insects, differing only in the undeveloped state of the wings. Among various other distinctions, also, the formation of the elytra held a prominent place, those organs being in the earwigs soft and leathery, crossing each other slightly at the tips, and not entirely covering the wings, while in the beetles they are hard and horny, and parallel for the whole of their length, the wings, also, being entirely concealed.

From the *Orthoptera*, which in other points they closely resemble, they differ in the manner in which the wings are folded, those of the cockroach, cricket, etc., lying in longitudinal folds alone, while in the earwigs they are folded transversely, as is the case with the beetles. The elytra, too, of the *Orthoptera* are strongly veined.

These points of difference being taken into consideration, it was determined that the earwigs constituted a separate order, and the title *Dermaptera* was for a long time applied to them. Some confusion, however, arising as to the insects comprised in the group, many entomologists including the cockroaches and others among the *Dermaptera*, the word *Euplexoptera*, or 'beautifully-folded wings,' was suggested by Professor Westwood for the earwigs, and this arrangement is now almost universally recognised.

Concerning the popular name, too, a great deal of misconception has arisen. More especially among the lower classes, the earwig is held in considerable dread, owing to its reputed aptitude for entering the human ear, and penetrating by some remarkable channel to the brain, which organ is supposed to be so affected by the presence of the insect that madness immediately follows. It is, of course, unnecessary to point out the impossibility of such a proceeding on

the part of the earwig, no passage existing between the brain and the external ear, and the entrance of the insect for more than a very short distance being completely out of the question.

A more probable derivation of the popular title is from the two words 'ear' and 'wing,' *i.e.*, 'earwing,' the form of the wing of the earwig being almost exactly that of the human ear.

There must be few who are not practically acquainted in some degree with the common earwig. In many ways the insect is objectionable enough, its destructive habits, among fruit and flowers especially, causing it to be regarded with almost universal disfavour. Yet the earwig, like every other insect, is worthy of the most detailed study and examination, and the more time we devote to its structure and habits, the more points of interest do we discover.

The most superficial observer can scarcely fail to notice the remarkable structure placed at the extremity of the body, which closely resembles a pair of curved forceps. The popular idea, leaping at once to the conclusion that everything connected with the insect must of necessity be prejudicial to mankind, holds that these forceps are created for the express purpose of nipping human fingers. As barely one earwig in ten thousand ever comes into contact with a human being, it is scarcely likely that such weapons would be furnished to the insects against a foe they were so little likely to meet, and the theory is therefore hardly tenable. Their real object we shall presently see.

The elytra, as before stated, are of a soft and leathery nature, therein differing considerably from the hard and horny wing cases of the beetles. In appearance, they somewhat resemble the corresponding organs of the *staphylinidæ* (which, it will be remembered, form one of the principal groups of the coleoptera), being very small in proportion to the size of the wings which they protect, and leaving several segments of the abdomen entirely uncovered.

The wings themselves are most wonderful and beautiful objects, although few have an opportunity of seeing them when thoroughly extended. And for this reason, that the membrane of which they are composed is of so delicate a nature, and the innumerable folds are so difficult to expand, that it is almost impossible to spread them without completely tearing them to fragments, and the still more difficult task of re-folding them and packing them away beneath their cases has probably never yet been performed by man.

How, then, does the insect contrive to perform these operations, neither of which occupies more than a second or two from first to last?

It will be remembered that the *staphylinidæ*, as mentioned in one of the previous papers of this series, are accustomed to fold their wings by the assistance of the extremity of the body, which is bent over the back for that purpose. The same is the case with the earwig, which is enabled to fold its infinitely more complex wings by the assistance of the tail forceps.

The rapidity with which the operation is completed is perfectly marvellous. The insect alights, gives the wings a rapid shake, which has the result of throwing them into longitudinal folds, turns the body over the back, and daintily folds them up with the forceps; it then pushes them beneath the elytra, which it finally smooths over them, the whole operation consuming barely two or three seconds.

In order to facilitate the folding of the wings, these organs are formed of a number of strong nervures, running longitudinally, between which is spread the membrane of which the wings are composed. These ribs, or nervures, are furnished with a double set of leathery hinges, so that they can be folded back upon themselves in somewhat the same manner as the cover of a book.

The life-history of the earwig, at least as regards one point, is probably unique in the insect world.

It is a well-known fact that insects, as a general rule, never see their own offspring; far less do they tend them and bring them up. The object of their existence seems to terminate as soon as the eggs are deposited, the parent insect seldom surviving that operation for more than a few hours. In very few cases is she still living when the eggs are hatched, the larvæ being able from the moment of their birth to take care of themselves.

Some insects, such as the bees and ants, are perfectly helpless while in their larval condition, and are therefore nurtured and tended by perfect insects. But not by the parents, although they may still be living, their object in life seeming to be entirely confined to the deposition of eggs.

The earwig, however, furnishes a remarkable exception to this rule, for the maternal parent not only continues to exist after her eggs are deposited, but actually watches over and guards her progeny from danger. It is by no means unusual, in the early spring, on turning over a stone or log, to see the parent earwig sitting over and guarding her eggs, or, a week or two later, her young brood. I have myself found as many as five or six batches of eggs, each guarded by the mother, in the course of a single day.

The parent insect may be repeatedly removed from her post, but will as often make her way back to the spot, giving even her very life in behalf of her offspring.

The eggs are usually placed by the parent earwig in some moist and damp spot, and are shifted to another situation if the locality should show signs of becoming too dry for their welfare.

Both the larvæ and pupæ of the earwig closely resemble the imago, and by a casual observer would probably be considered as adult insects. The larvæ, however, are without traces of wings, and the pupæ only possess those organs in a rudimentary form, while the tail forceps are without the strong curve found in those of the perfect insect. The antennæ, too, are formed of fewer joints.

Several species of earwigs inhabit Great Britain, all of them, with a single exception, being tolerably common. Most of them, however, are so similar in habits and appearance to the common species (*Forficula auricularia*) that a separate description is unnecessary, and we therefore pass to the solitary rarity in the group, namely, the Giant Earwig (*Labidura gigantea*).

As its name implies, this insect is far superior in size to the commoner species. It is an inhabitant of the sea-coast, dwelling among the rocks during the day time, and venturing out at night in search of prey.

The forceps of the insect, which are very long in proportion to the size of the body, are of a rather remarkable form, being almost straight, without the decided curve found in those of our common species. In the female, these organs are comparatively small.

Among the foreign earwigs, also, there is, curiously enough, both in form or habits, but little variety to

what we might expect when we take into consideration the strange developments of structure found in insects of other orders. One species is, however, remarkable for the enormous size of the forceps, which, at any rate in the male insect, fully equal the entire length of the body.

We now come to the *Orthoptera*, or 'straight winged' insects, so called because the wings can be folded longitudinally only, and not transversely, as can those of the beetles and earwigs. The order comprises the insects popularly known as Cockroaches, Grasshoppers, Crickets, Locusts, etc.

Among the other distinguishing characteristics of the insect of this order may be mentioned the construction of the elytra, which are tough, leathery, and strongly veined, and the formation of the mouth, which is furnished with jaws suitable for cutting the substances which are selected as food. This formation of the jaws effectually distinguishes the *Orthoptera* from the *Heteroptera*, which otherwise they closely resemble, and which are provided with a beak, or proboscis, through which fluids can be sucked into the mouth.

The *Orthoptera* are usually considered as being divided into four groups, the first of which, viz., the *Cursoria*, or 'runners,' comprises the rather unpleasant insects bearing the popular title of Cockroaches.

Our common British cockroach must be familiar to all, for, although it is not an indigenous inhabitant of Great Britain, there is now hardly a part of the country in which it is not to be found in abundance.

Male and Female Cockroaches.

The insect is perhaps more commonly known by the erroneous appellation of 'black-beetle,' a very mistaken title, the insect being neither black nor yet a beetle.

There are few creatures more thoroughly detested than the cockroach, and certainly not without some reason, for it cannot be denied that it is both mischievous and destructive, as well as being possessed of a most unpleasant odour. Yet these disadvantages are fully counterbalanced by the benefits which it confers upon us, and to which we shall shortly have occasion to refer.

There are comparatively few houses which are not infested by these insects. During the day time they keep carefully out of sight, knowing instinctively the danger of making their appearance. As soon, however, as the house is closed for the night, they emerge from their retreats, and proceed to forage in search of food. If a light be suddenly brought into a room, the kitchen more especially, during the hours of darkness, a strange spectacle presents itself. The floor and walls are almost black with cockroaches of all sizes, scampering with all possible speed to their holes, or shrinking in the corners in hopes of avoiding observation.

Among these cockroaches will be found four distinct forms, viz., the larva, the pupa, the perfect male, and the perfect female.

The larva and pupa, as is the case with all the *orthoptera*, closely resemble the perfect insect, the chief point of difference lying in the absence of wings.

The two sexes of the adult insect differ very considerably in appearance. The male, which is by far the more handsome, may be easily distinguished by the superior length of his antennæ, and by the possession of wings, which, in the female, are present only in a rudimentary form; in general appearance, too, he is slighter and more graceful. The head, in both sexes, is only partly visible, being almost entirely concealed beneath the broad and shield-like thorax. The colour of the insects is a rich brownish red.

It is, at first sight, somewhat difficult to understand how the cockroach should have contrived to spread itself so completely over the country. In the first place, of course, it must have been imported by means of ships from the countries of which it was a native. But, so are many other insects, which, although common enough in the neighbourhood of the docks, are seldom or never found at any distance from those localities.

With the cockroach, however, it is a different matter. The insect is by nature a lover of warmth, and is therefore greatly attracted by the heat of the kitchens of the neighbouring houses. Once having taken up its quarters, it is easily transferred from house to house in numberless ways, chief among which may be mentioned the laundress' baskets, and the bundles of firewood from the grocers' shops. Hampers, etc., sent by rail, are tolerably certain to harbour a number of the insects, so that their talent for spreading themselves over the country is easily explained.

Once fairly within a house, it is an almost impossible task to thoroughly exterminate them. Insect powders may be employed with apparently the best results. Every morning the floors are found to be strewed with the dead and dying in all stages of development. Jars of treacle or stale beer are placed in the corners of the room, and are found almost choked up with corpses in the morning. Daily their numbers diminish, and in a week or two the house is supposed to be cleared of the pests, and the campaign is relaxed.

A month afterwards the insects are as numerous as ever. Yet the baskets and firewood have been carefully examined, and the greatest precautions taken against introducing even a single specimen into the house. Whence, then, have these myriads appeared?

The matter is easily explained. The insect powders did their duty well enough, and destroyed every living insect. But they could not damage the eggs which

had been already deposited, and which, of course, escaped without the slightest injury.

The manner in which the eggs of the cockroach are laid is most singular. Unlike those of other insects, they are enclosed in a tough, horny case, shaped somewhat like an oval purse, with a serrated ridge running along one side, and corresponding to the clasp.

Male Cockroach with wings spread.

Each of these cases contains sixteen eggs, each in a separate cell, and placed in two longitudinal rows, lying in much the same manner as do peas in a pod. When the time approaches for the eggs to hatch, the case opens at the clasp, so to speak, and the young larvæ emerge, their late habitation again closing and seeming to all appearance entirely unchanged.

How these curious egg-cases, which are rather more than two-fifths of an inch in length, are produced has not yet been discovered.

We must not conclude without a few words concerning the services rendered to mankind by the cockroaches.

In the first place, these insects perform the important duties of scavengers. Every piece of wasted food, every scrap upon the floor serve them for provisions, and material is thus removed which, if allowed to remain and putrefy, would probably be productive of serious consequences.

In the next place, cockroaches, although unpleasant enough in their way, are the greatest foes of other and still more disagreeable insects, devouring them with the greatest eagerness, and never allowing one to remain alive in the house in which they have taken up their quarters. So much is this the case, that cockroaches are actually welcomed on board ship, the sailors knowing that they will shortly free the vessel from the insect pests which had before been so troublesome.

Although the common cockroach is not a native of Great Britain, there are other species of the same genus (*Blatta*) which are indigenous to our islands. One of these is a cockroach without a popular name, but which is scientifically known as *Blatta ericetorum*. This is quite a small insect, being scarcely one-third of an inch in length, and of a pale yellow colour. As its name implies, it is found among heath.

Another of the outdoor species is the Field Cockroach (*B. germanica*), a doubtful British native. The egg-case of this insect has the peculiarity of containing no less than thirty eggs.

The Cockroaches were formerly supposed by many entomologists to constitute a distinct order, which they termed *Dictyoptera*, a word signifying 'reticulated-winged,' and which was applied to them on account of the curiously veined elytra.

(To be continued.)

'How I Teach Elementary Science.'

FOURTH SCHEDULE SUBJECTS: MECHANICS.

BY RICHARD BALCHIN.

ENOUGH has now been said of the 1st stage to show how the whole of this division of the subject is treated. I now pass on to stage 2. Speaking generally, the whole subject is thus arranged :—

1st Stage—'Matter; its states and properties.'
2nd „ 'Matter acted upon by force.'
3rd „ 'Force accomplishing work.'

The code of 1881 gives the following syllabus :—

1, Matter in motion; 2, The weight of a body, its inertia and momentum; 3, Measures of force; 4, Work done by a force; 5, Meaning of the term energy; 6, Energy cannot be destroyed; 7, Modern notions as to heat.

In this scheme, I would change the wording of the 6th item, and say 'Neither force nor matter can be destroyed or created;' and in the 5th item include, 'the meaning of conservation of energy.' My reasons for doing so will appear by-and-bye. In the second stage, as in the first, I have prepared a detailed syllabus of lessons for the year. It is as follows :—

1. Motion of matter; definition of motion and velocity; motion the law of the universe; absolute and relative motion and rest: uniform, accelerated, and retarded velocities.
2. Force, the producer of motion; definition; measure of force and of velocity; momentum and inertia.
3. Newton's laws of motion; parallelogram of motion and of forces.
4. Work; definition; distinction between force and work; unit of work; measure of work; horse power of steam engine.
5. Energy; definition; potential and actual energy; conservation of energy; distinction between force, energy, and work.
6. Heat, a force; mechanical equivalent of heat; old and modern notions respecting heat.
7. Natural forces; all force naturally existent; force of gravitation; chemical force; electrical force; heat force; change from one kind of force to another; indestructibility of force as of matter; uncreatability of force as of matter; purpose of machinery, to connect a force with the work to be done, and to direct such force.
8. Gravity and weight; definition of gravity and of weight; meaning of the statement 'gravity varies inversely as the square of the distance;' same law as applied to light and heat.

I have no hesitation in saying that this is the most magnificent series of subjects for the exercise of the powers of the educator that can well be arranged. If a boy, under the influence of a philosophical teacher, has two intellectual drills per week on the above plan, he will, by the end of the year, have received such an accession of mental power as shall fit him, in after life, to think for himself, and think correctly; to act for himself and for others, worthily; and, in short, to take his place in the ranks of the thoughtful citizens of his country. And this is the character we teachers should lay ourselves out to form. Of course, if there are some among us who never think for one moment

of forming character at all, but only of making percentages and getting grants, to such it signifies but little what series of subjects or what schemes they adopt. They are mere creatures of Robert Lowe, and not educators at all. These are happily, however, the minority. Most of us have seen the gradual growth of intellectual power, under the influence of our teaching. Most of us have had experiences similar to the one I passed through a few evenings ago. It was this. I am a vice-president of a large Liberal club. A gentleman on the committee made a lucid and powerful speech at an important general meeting. He was one of my old British-school boys. Now he is the father of a family and one of the most respected and influential men in his neighbourhood. As I sat and listened to him I distinctly recognised the mental moulding he had received when a boy at the old school—a school where there was little of code, but much of soul. I have my reward. I ask, Is it not this 'mind-shaping' that produces Garfields? And how many 'Garfields' are likely to come from our schools? I am told that this Mechanics is a 'dry' subject! Is it? Only a few days ago I was giving a lesson on the conservation of energy. Warming with the subject, I described a mountain torrent suddenly dammed up by a great fall of earth across its path. Pictured the vast accumulation of pent-up waters. Spoke of the tremendous potential energy there generated; of the threatening trembling of the barrier, the fearful crack, the fall, the rushing of the waters, and their dreadfully destructive energy now all actual. Eighty little eyes flashed from the desks with the fires of excitement; scarce one of the boys but what had risen from his seat, blazing all up with ardour, and wanting to ask questions about it. A dull subject! Let none but the 'Dry-as-dusts' say so. And I cannot but feel that in a school which is not a mere valley of dry bones without a soul, this subject may be the means of generating such an amount of potential mental energy, that the boys possessing it, and making it actual in their after lives, shall have reason to bless the force of soul of the teacher that originated it.

There is, perhaps, one disadvantage about this second stage. It is not capable of being illustrated by so many experiments of a striking character, as are the first and third stages; nor will any mechanical contrivance, or apparatus, that the boys so delight in, be needed. But on the other hand, all the phenomena of everyday life, and all the natural objects around us can be put into requisition. It is essentially a mind-expanding and thought-generating subject. One thing however is needful. The teacher must himself thoroughly grasp the questions involved. It is a most remarkable thing, true nevertheless, that there are some head and assistant teachers who have three, four, and even more 'science certificates,' who are yet unable to explain and illustrate some of the simplest phenomena of everyday life. I know of at least one man who holds thirteen science certificates. Just take a long breath, and imagine a single finite mind with 'advanced' knowledge upon thirteen different sciences! And yet such a one at a loss to explain before boys the striking of a match and the lighting of a tallow candle! I am afraid these 'advanced scientists' have become acquainted with the terms in which scientific facts are expressed, rather than with the ideas underlying those terms. As the Education department seems determined to enter upon a new path, and encourage real mental culture, why not insist that the first science certificate granted shall be for 'Natural Philosophy'? And on the examination paper let at least half the questions set relate to the method of teaching the subject. And grant no certificate at all until the candidate has really given a satisfactory lesson to a class of children or young men, on the particular subject he desires to pass in. For why give a certificate, enabling a person to teach a certain science, before you have ascertained whether or not he can teach at all? If graduates from universities are going to become assistants in our schools simply on the strength of having given some evidence of the possession of, it may be, a crude stock of undigested book knowledge, then 'the Lord deliver me from Sir Harry Vane.' For if such a one be as much my social superior as Lord Randolph Churchill himself, he would still be not worth his salt. Superior social position! This is surely the seasoning in Sam Weller's pies that was supposed to make up for the absence of good meat.

In next month's issue I propose giving an outline of a lesson on 'Motion of Matter.'

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'How I Teach Arithmetic.'

(*Continued from page* 377.)

BY WILLIAM SPENCER,

Author of 'Spencer's Exercises in Arithmetic.'

Another example:—If 16 men in 6 days of 10 hours each build a wall 480 yards long and 8 feet high, what length of wall 12 feet high could 20 men build in 5 days of 12 hours each? Here we see first that the answer requires to be in length of wall, hence the 480 yards is placed above the line to the extreme left. We now take the various (4) ratios as they come in the question, so as to be careful that we omit none. As 16 men built the 480 yards, 20 men can build more, hence the 24 is placed above the line as the numerator or multiplier, and the 16 below the line as the denominator or divisor. In considering the days, we conclude that less wall will be built in 5 days than was done in the 6 days, hence the 5 will be above the line and the 6 below it. Next, as the hours a day in the consequent (12) are greater than those in the antecedent (10), a longer wall will, on that account, be built, hence the 12 above and the 10 below the line. Lastly, as the required wall is to be 12 feet high, against the given one being 8 feet, it is evident that, being a higher wall, a shorter length of it would be built—$\frac{8}{12}$ of it. Hence the arrangement and work will be as follows:—

yards m. d. hr. ft.

$$\frac{30\ \cancel{480}^{\ 24} \times \cancel{20}^{\ 2} \times 5 \times \cancel{12}^{\ 3} \times \cancel{8}^{\ 4}}{\cancel{16}^{\ 8} \times \cancel{6}^{\ 3} \times \cancel{10}^{\ 5} \times \cancel{12}^{\ 3}} = \frac{1200}{3} = 400 \text{ yds. Ans.}$$

Here we notice, as was observed in working Compound Fractions and Multiplication of Fractions, that immense labour is saved by cancelling the numbers as above. Often the *whole* of the lower numbers will vanish, as in the above, since the 3 would go into the 30; but second, or compound cancelling, is difficult to follow, except to the person who has performed it, and is somewhat difficult to show clearly on paper. The above work can be simplified, as in the previous question, by putting the lowest ratios only:—

$$\frac{\text{yards}\quad \text{m.}\quad \text{d.}\quad \text{hr.}\quad \text{ft.}}{40\ \cancel{480}\times 5\ \times\cancel{5}\times\cancel{6}\times 2}{\cancel{4}\ \times\cancel{6}\times\cancel{5}\times\cancel{3}} = 400 \text{ yards. Ans.}$$

Here the 5 and 6 above the line cancel the 6 and 5 below the line, and the 4×3 (12) below the line goes 40 times into the 480, hence the result.

The most common error into which a boy falls in arranging or 'stating' a question, is that he loses sight of what the answer requires to be in, hence the importance of having the number first put down distinctly headed, as in the above, 'yards,' length of wall. For instance, in the above question, a boy takes the two terms, 16 men and 20 men, and reasons thus:—'20 men will do it in fewer days,' or 'they will require shorter days,' forgetting that the answer required is not the number of days, or the length of the days, but length of wall. Impress well that the eye and mind must be well concentrated on the antecedent—the number first put down—whose consequent is required. In working such sums on the board, I often test the scholars' comprehension by myself presenting the question to them falsely, as above explained, but boys of ordinary capacity easily detect the fallacy. In working Compound Proportion, the number done on the board is very large, as I find that the slower intellects here especially require 'line upon line,' in order to state correctly a question that contains many terms.

We will now work out four questions in Compound Proportion and comment where thought necessary. The first three are taken from my own exercises in 'Reduction and Proportion,' and the fourth from the recent Queen's Scholarship Examination,—July, 1881.

(1) If 150 yards of a trench, which is to be 800 yards long, be dug by 8 men in 5 days, in how many days would 10 men complete the remainder? (No. 47.)

Here $800 - 150 = 650$ yards to be completed. This step, to a feeble thinker or rote worker, is the most puzzling, as he expects, somewhat naturally, that all the terms are expressed in working order. Now state as below, putting the ratios in their simplest form,—

$$\frac{\text{days}\quad \text{yds.}\quad \text{m.}}{\cancel{5}\times\cancel{13}\times 4}{3\quad\cancel{5}} = \frac{52}{3} = 17\tfrac{1}{3} \text{ days. Ans.}$$

In the yards, instead of $\frac{650}{150}$, each number is divided by 13, and in the men the $\frac{8}{10}$ is divided by 2.

(2) If £380 in $2\frac{1}{2}$ years gain £45 interest, what is the rate per cent. per annum—that is, the interest of £100 for 1 year? (No. 84.) Here we will put down the terms in full, giving the time in *half*-years (5 and 2) and then cancel.

$$\frac{\pounds\quad \pounds\quad \text{yr}}{9\ \cancel{45}\times 5\ \cancel{100}\times 2}{19\ \cancel{380}\times\cancel{5}} = \frac{90}{19} = £4\ \tfrac{14}{19}. \text{ Ans.}$$

In considering what the answer requires to be in—money—we observe that we have three expressions of money, but that our answer requires to be in interest money, not principal, which is money out at and producing interest, and will be further explained under Percentages.

(3) A tunnel 800 yards long was undertaken to be excavated in 36 days, but at the end of 30 days it was found that 80 men had only completed 600 yards. How many additional men must be employed to finish it in the remaining 6 days? (No. 38.) This is another puzzling question to boys who work by rote rather than by reason, who as I sometimes remark, use their pencil more liberally than their brain. We have three preliminaries to consider before we can formally state the question:—first, the remnant of the tunnel, which must evidently (800 – 600) be 200 yards; second, the number of *additional* men. This latter is a sore puzzle to most boys, but if we find how many men the work will really take, we can see how many that is above the number previously employed, and consequently must give the number of additional men. Thirdly, the number of days (36) a boy is puzzled what to do with, not seeing that it does not enter into the working of the question at all, as we have the ratio for the days in the 30 and 6 which make up the 36. I now cause the class to read the question in its prepared and amended form,—If 600 yards be excavated in 30 days by 80 men, how many men can do 200 yards in 6 days?

$$\frac{\text{men}\quad \text{yds.}\quad \text{d.}}{80\times 1\quad 5}{3\times 1} = \frac{400}{3} = 133\tfrac{1}{3} \text{ men,}$$

hence $133\frac{1}{3} - 80 = 53\frac{1}{3}$ additional men. Ans.

As $\frac{1}{3}$ of a man is an anomalous expression, it might be viewed as a man for a third of the time—that is, for 2 days out of the 6. In the statement we only put down the lowest ratios, 1 to 3 instead of 200 to 600, as the 200 yards would take less doing than the 600; and 5 to 1 instead of 30 to 6, as the shorter time (5 days) would require more men than the 30 days required. Impress well that when arranging a pair of terms we consider *them* only for the moment as if there were no other terms, the others being left for their own separate consideration.

(4) How many hours a day must 16 Englishmen and 72 Frenchmen work for 34 days to do a piece of work that 24 Englishmen and 12 Frenchmen can do in 95 days of 6 hours each, if 5 Englishmen can do as much in a day as 6 Frenchmen? (Q S. July, 1881.) As 5 E. = 6 F., 60 E. = 72 F, and 10 E. = 12 F.; hence 16 E. + 60 E. = 76 E., and 24 E. + 10 E. = 34 E. Having eliminated the Frenchmen by converting them into their equivalents of Englishmen, the question may now be read,—How many hours a day must 76 men work for 34 days to do a piece of work that 34 men can do in 95 days of 6 hours each?

$$\frac{\text{hrs.}\quad \text{m.}\quad \text{d.}}{6\times\cancel{34}\times 5\ \cancel{95}}{4\ \cancel{76}\quad\cancel{34}} = \frac{30}{4} = 7\tfrac{1}{2} \text{ hours. Ans.}$$

As to the statement, the answer requires to be in length of day, hence the 6 hours given is first put down; and as 76 men will require shorter days, the greater number is put below the line; but as the number of days is less, only 34 against 95, the greater number is placed above the line. The two 34's cancel each other, and 19 divides 95 and 76.

As any question solved by Proportion may be worked out from first principles, we will bring our remarks on the teaching of Proportion to a close by thus working out the above exercise, making an hour's work the unit of operation.

$34\times 95\times 6 = 19{,}380$, hours' work in the whole.

$19{,}380 \div 34 = 570$, hours' work in 1 day by 76 men.

$570 \div 76 = 7\frac{1}{2}$, hours per day. Ans.

If we carefully compare this latter process with the former, we see that the operations are exactly identical, except the shortening of the work in the former by cancelling, and this cancelling is the chief advantage that Compound Proportion has over working by first principles, as it can generally be extensively resorted to.

(To be continued.)

Recent Inspection Questions.

[*The Editor respectfully solicits contributions—all of which will be regarded as* STRICTLY PRIVATE—*to this column. For obvious reasons, it cannot be stated in which district the questions have been set.*]

Arithmetic.

STANDARD I.

(1) Add together,—five, twenty-three, three hundred and nineteen, and seven. Ans. 354.

(2) From five hundred and six, take two hundred and eighty-four. Ans. 222.

(3) Add together,—thirty-six, seven, five hundred and fourteen, and sixty-two. Ans. 619.

(4) From six hundred and one, take one hundred and fifty-seven. Ans. 444.

STANDARD II.

(1) Take fourteen thousand and five from two hundred and nine thousand and four. Ans. 194,999.

(2) Divide twenty-one thousand and eight by eight. Ans. 2,626.

(3) Multiply four thousand two hundred and thirty six, by sixty-four. Ans. 271,104.

(4) Multiply 29,432 by seven. Ans. 206,024.

STANDARD III.

(1) Add together,—three hundred and twenty-seven thousand eight hundred and ninety-one pounds eighteen shillings and tenpence, and one hundred and eighty-seven thousand three hundred and sixty-one pounds six shillings and sixpence. Ans. £515,253 5s. 4d.

(2) Find the difference between fourteen thousand two hundred and thirty-four pounds sixteen shillings and elevenpence, and one hundred and sixteen thousand one hundred and sixty-four pounds and eightpence. Ans. £101,929 3s. 9d.

(3) Divide two hundred and sixty thousand nine hundred and forty-six by sixty-three. Ans. 4,142.

(4) Write in figures in *separate* lines,—seven, seventy, seven million and seventeen, and seventy thousand.

STANDARD IV.

(1) Reduce one hundred and fifty-one thousand five hundred and thirty-six pounds eight shillings and three halfpence to halfpence. Ans. 72,737,475.

(2) Multiply 204 tons 4 cwt. 1 qr. 17 lbs., by 45. Ans. 9,189 tons 18 cwt. 9 lbs.

(3) Reduce 205 years, 7 months, 2 weeks, 4 days, 2 hours, 32 minutes to seconds. (Note, 13 months = 1 year). Ans. 6,465,666,720.

(4) Divide three hundred and thirty-seven thousand one hundred and one pounds and ninepence by forty-seven. Ans. £7,172 7s. 3d.

(5) Bring 424 yards to poles, and then back to feet and inches, and explain clearly why you multiply by two, when you divide by $5\frac{1}{2}$. Ans. 77 poles $\frac{1}{2}$ yard and 15,264 inches.

STANDARD V.

(1) Find the value of 14,121 miles, 7 furlongs, 17 poles, $2\frac{1}{2}$ yards at £29 6s. 8d. per mile. Ans. £414,243 5s. 4d.

(2) If one yard of wire cost five shillings and fourpence, what will sixteen poles, two yards, one foot cost? Ans. £24 1s. $9\frac{1}{2}$d.

(3) Make out the following bill:— 7 oz. of tea at 4s. per lb., 16 lbs. of soap at 3d. per lb., 19 st. of flour at 1s. 6d. per st., and 100 quills at 5s. per 1,000.

£	s.	d.
0	1	9
0	4	0
1	8	6
0	0	6
1	14	9

Ans.

(4) If 16 men build a wall in 4 days, how long will it take 28 men to do it? Ans. $2\frac{1}{4}$ days.

(5) Find the cost of two gross of pencils at one shilling and three halfpence per doz. Ans. £1 7s.

STANDARD VI.

(1) If $\frac{3}{4}$ yard cost $\frac{3}{8}$ of a sovereign, what will $\frac{3}{8}$ of an English ell cost? Ans. 8s. $10\frac{3}{8}$d.

(2) If five men paint a house in a fortnight, how many men will do it in 23 days 3 hours? (Note, 9 hours = 1 day). Ans. 3 men, if the fortnight = 14 days; $2\frac{1}{7}$ men, if 12 days are reckoned.

(3) Simplify:— $\dfrac{1\frac{3}{5} \text{ of } 2\frac{3}{4} \div 5}{\frac{25}{36} + \frac{10}{9} - 1}$ Ans. $\frac{33}{34}$.

(4) How many half-crowns are there in 240 florins? Ans. 192.

(5) If half-a-crown will pay the carriage of 2 lbs. from Newcastle to London (272 miles), how much will it take to pay the carriage of 30 lbs. from Newcastle to Berwick (67 miles). Ans. 9s. $2\frac{11}{136}$d.

(6) Multiply $2\frac{2}{7}$ by $1\frac{31}{32}$, and subtract $4\frac{1}{27}$ from the result. Ans. $\frac{25}{54}$.

Grammar.

STANDARD IV.

Parse:—

(*a*) His sword of sharpness in his hand he took.

(*b*) One of the chickens went to the trough to drink.

STANDARD V.

Parse and analyze:—

(*a*) The humming bird in the picture is sitting on its eggs.

(*b*) There is great advantage in a long dela y

STANDARD VI.

Parse and analyze:—

(*a*) The sea, which was very rough, soon went down.

(*b*) The children who saw it, fed it with crumbs.

Dictation.

STANDARD I.

Next day a friend came to see Jane, and once more the poor bird got no food.

STANDARD II.

The eggs are prepared for food in various ways, and some people are very fond of them. The shells also are made into cups and ornaments of different kinds. The ostrich is often hunted on horseback, but so rapid is its flight that the hunters would seldom succeed in catching it.

STANDARD III.

When the mother went to take a mournful look at her child's grave. On going to it, she found, to her great surprise, her lost dog. It was lying in a deep hole which it had scratched for itself over the child's grave, probably hoping to get a little nearer to the object of its affection. It was thin and weak, but hunger and cold had not overcome its love nor lessened the force of its attachment.

STANDARDS IV., V., AND VI.

The moon shone through the opening at the mouth of the creek by which I had entered the forest, and, considering this the best means of escape, I darted toward it like an arrow. It was hardly a hundred yards distant, and the swallow could scarcely have excelled me in flight; yet, as I turned my head to the shore, I could see several dark objects dashing through the brushwood at a pace nearly double to my own. By their great speed, and the short yells which they occasionally gave, I knew at once that these were the much dreaded grey wolves.

—o—

Publications Received.

Arithmetic—

(1) Bemrose's Standard Arithmetic. Parts I. to IV. Bemrose and Sons.
(2) Harvey's Examination Arithmetic. Blackie and Sons.
(3) Harvey's Key to Examination Arithmetic. Blackie and Sons.
(4) Knight's Algebraic Factors. Blackie and Sons.
(5) Longman's Modern Series Arithmetic. Parts I. to IV. Longmans, Green, and Co.
(6) Longman's Quarterly Arithmetic Tests. Standards II. to VI. Longmans, Green, and Co.

Domestic Economy—

(1) Warren's Cookery Cards for the Kitchen. Bemrose and Sons.

English Literature—

(1) Lewis's English Language. E. Stanford.
(2) Macaulay's Essay on Moore's Life of Byron. W. and R. Chambers.

Geography—

(1) Keith Johnston's School, Physical, and Descriptive Geography. E. Stanford.
(2) Meiklejohn's Geographical Reader, III. W. and R. Chambers.

History—

(1) Sanderson's History of the British Empire. Blackie and Sons.
(2) Young Student's English History Reading Book. National Society.

Miscellaneous—

(1) Landell's Boys' Own Toy-Maker. Griffith and Farran.
(2) Taylor's How to Prepare Notes of Lessons. National Society.
(3) The Cambridge Examiner. Nos. VII. and VIII. E. Stanford.
(4) The Public Schoolboy's Quiet Hour. Partridge and Co.

Music—

(1) Crampton's Songs for Young Singers. B. Williams.

Prize Books—

(1) Henty's Out on the Pampas. Griffith and Farran.
(2) Gellie's A Gem of an Aunt. Griffith and Farran.
(3) Bray's We Four. Griffith and Farran.

Periodical Literature—

(1) Ward and Lock's Universal Instructor. XII. Ward, Lock, and Co.

Reading Books—

(1) Longman's Illustrated Readers. I. to III. Longmans, Green, and Co.
(2) Longman's Poetical Reader. Longmans, Green, and Co.
(3) Edgeworth's Tales. G. Bell and Son.
(4) Beale's Great Englishmen. G. Bell and Son.

Science—

(1) Prince's Principles of Physiography. J. Heywood.
(2) Jago's Inorganic Chemistry. Longmans, Green, and Co.

Writing—

(1) Tidmarsh's Modern Copy Books. Longmans, Green and Co.

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Engagements for November.

November	2.	Parliamentary and Law Committee, N.U.E.T.	7.30 p.m.
		Geological Society	8 p.m.
,,	3.	Linnean Society	8 p.m.
		Education Society. Public Meeting.	
,,	4.	Finance of Orphanage, N.U.E.T.	7.30 p.m.
,,	5.	Meeting of Executive, N.U.E.T.	11 a.m.
,,	7.	2nd B.Sc. Exam., London University.	
,,	9.	Anthropological Society	8 p.m.
,,	11.	New Shakspere Society.	8 p.m.
		Finance of Prov. Society, N.U.E.T.	7 p.m.
		General Board, N.U.E.T.	8 p.m.
,,	14.	2nd M.B. Exam., Honours, London University.	
		Finance and General Purposes Committee, N.U.E.T.	7.30 p.m.
		Education Society. 'Joseph Payne as an Educationist,' by C. H. Lake, B.A.	7.30 p.m.
,,	16.	Geological Society	8 p.m.
		Parliamentary and Law Committee, N.U.E.T.	7.30 p.m.
,,	17.	Royal Society	4.30 p.m.
		Linnean Society	8 p.m.
,,	18.	Executive Meeting, N.U.E.T.	
,,	19.	Organisation Committee, N.U.E.T.	10 a.m.
,,	22.	Scripture Examination, London University.	
		Browning Society. 'On Browning's Works,' by G. Barnett Smith, Esq.	
,,	23.	Anthropological Society	8 p.m.
,,	24.	Royal Society	4.30 p.m.
,,	28.	Education Society. Open Meeting.	
		M.S. and M.B. Examinations, London University.	
		Finance and General Purposes Committee, N.U.E.T.	7.30 p.m.
,,	30.	Royal Society Anniversary Meeting	4 p.m.

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*** *We regret that, owing to the great pressure upon our space, the 'Monthly Notes' and 'Gossip' are this month crowded out.*

Publications Reviewed.

*** We are sorry to disappoint the many friends who desire us to quote the price of each work noticed in our columns. This we would respectfully point out is the publishers' duty and not ours; we give publicity enough to a book when we review it. Our readers should peruse the advertisements in our pages, and failing to find the price here, it would be no great trouble or expense to drop a line to the publishers whose name and address we will gladly give.

Lectures on Teaching. By J. G. Fitch, M.A. Cr. 8vo, 436 pp. London: Cambridge Warehouse, 17, Paternoster Row.

FIRST NOTICE.

The Head-masters and the Assistant masters of our great public schools have been chiefly chosen from among the distinguished graduates of our universities, and the memory of their own school-training has been their principal guide in determining the methods which they have afterwards adopted. The traditions of the past have been of late greatly interfered with, not only by 'the spirit of the age,' which demands a more general culture than that which has been hitherto afforded in most schools, but also by the enforced introduction of a 'modern side,' which does not confine its attention to language and mathematics. To effect the greatest economy in 'power' as well as in 'time' requires much skill in school management, and this skill does not often 'come by nature.' The Senate of the University of Cambridge in 1879 appointed a 'Teachers' Training Syndicate,' 'with a view to encourage the study of the principles and practice of the art of teaching.' The volume before us contains the third series of lectures given to those members of the University who intended to adopt the profession of teacher, the preceding series having reference to the History of Education and Mental Science. Few men have had a more varied experience or a wider field of observation in reference to education than Mr. Fitch, and his opinions deserve far more attention than most of the imported theories which powerfully attract and dazzle, and then, like a passing meteor go into darkness. For all young teachers there is most valuable counsel in this book, and there are few experienced men who will not gain something from its perusal. The mere record of such sentiments as are scattered through the pages of this work issued from the Cambridge University Press is inspiring to those of us who have known what 'Teaching' has been in most 'colleges and schools'; and the ultimate national benefit which will result from the universal adoption of methods which 'shall make the work of honest learning and of noble teaching simpler, more effective, and more delightful to the coming generations,' is so vast as to challenge the attention of all who, like the author of these lectures, believe that in the art of teaching the discovery of scientific methods is possible, and their application practicable.

The fifteen lectures occupy four hundred and thirty-six pages, and treat of the Teacher, the School, Appliances, Discipline, Learning and Remembering, Examining, Preparatory Training, Study of Language, English Language, Arithmetic as an Art and as a Science, Geography and Fact-Lore, History, Natural Science, and the Correlation of Studies. Those who have studied the subject of Education in its modern developments will find no new or startling theory in any one of these admirable lectures. The results of long experience are presented generally in a clear light, and the methods by which good intellectual and moral training may be secured are sufficiently indicated. Mr. Fitch says, however, that 'this book is not, and does not profess to be, a manual of method,' but no attentive reader can fail to obtain from its pages much help in planning and developing the general or the individual parts of his school-work. Our space will not allow us to particularize, but each of the chapters is well worth a special study.

Here is a passage on the Ideal Teacher:—

'Now in regard to all the duties of life there has to be considered the correlation between the thing to be done and the doer of it; the qualities of the agent largely determine

the character and the results of the work. In all mechanical labour, in which matter alone has to be acted on, the physical strength and tactual skill of the artisan are the determining forces; his motives and moral qualifications have little to do with the result. But in the case of the schoolmaster, as in that of the priest, or of the statesman, mind and character have to be influenced; and it is found that in the long run nothing can influence character like character. You teach, not only by what you say and do, but very largely by what you are. Hence there is a closer correspondence in this department of human labour than in others between the quality of the work and the attributes of the workman. You cannot dissociate the two. And because in the profession of teaching the ruler or agent comes into closer contact with the person ruled than in any other profession, it becomes here specially needful to inquire not only what is the character of the work to be done, but what manner of men and women they should be who undertake to do it.'

And after showing the advantage of ample and accurate knowledge beyond mere professional limits, of a cheerful equable temper, as well as of quickness of eye and ear and of a cultivated voice, the author adds:

'And it need hardly be said here that the one crowning qualification of a perfect teacher is sympathy—sympathy with young children, with their wants and their ways; and that without this all other qualifications fail to achieve the highest results. The true teacher ought to be drawn towards the profession by natural inclination, by a conviction of personal fitness, and by a wish to dedicate himself and the best powers and faculties he has to this particular form of service. That conviction, if it once dominates the mind of a person in any walk of life, does much to ennoble and beautify even work which would otherwise be distasteful; but I know no one calling in which the presence of that conviction is more necessary, or its absence more disheartening than that of a schoolmaster. Teaching is the noblest of all professions, but it is the sorriest of trades; and nobody can hope to succeed in it who does not throw his whole heart into it, and who does not find a positive pleasure as he watches the quickened attention and heightened colour of a little child as he finds a new truth dawning upon him, or as some latent power is called forth. There is no calling more delightful to those who like it; none which seems such poor drudgery to those who enter upon it reluctantly or merely as a means of getting a living. He who takes his work as a dose is likely to find it nauseous. "The good schoolmaster," says Fuller, "minces his precepts for children to swallow, hanging clogs on the nimbleness of his own soul, that his scholars may go along with him." This means that he has enough of imaginative sympathy to project his own mind, so to speak, into that of his pupil, to understand what is going on there, and to think not only of how his lesson is being imparted, but also of how it is being received. But nobody can do this who is not fond of his work. That which we know and care about, we may soon learn to impart; that which we know and do *not* care about we soon cease to know at all, to any practical purpose.'

Mr. Fitch, when speaking of the choice of assistants, asserts that 'it is in the lowest class that the highest professional skill is often wanted.' We believe this so strongly as to say, unhesitatingly, that if our infant schools were under the best qualified mistresses the problem of popular education would be well nigh solved. Mr. Mundella, in his recent speech, rightly 'insisted upon better infant teaching—the foundation of all teaching'; and if the ultimate provisions of his new Proposals shall correspond with this expressed opinion, the Vice-President will have 'deserved well of his country.' The need of great skill in dealing with the minds of young children has been greatly overlooked.

The second and third lectures are full of valuable hints on the arrangements of the schoolroom, its 'comeliness, its furniture, and its adjuncts of library, museum, etc., which we cannot quote.

The important question of Discipline is discussed in the next chapter in great detail, but not more fully than it demands. The success of a teacher lies mostly in the character of his discipline. 'Force' may secure outward compliance with law, but how inferior is such discipline to that which wins a willing obedience through kindly 'personal influence.' Mr. Fitch points out the results of these opposite modes of government, but allows that 'it is better to gain obedience by force than not at all.' He shows the 'refuge of lies' to which impotent teachers betake themselves in entreaty, self assertion, threats, or futile appeals to a standard of moral obligation which the pupil is not able to acknowledge. Obedience must become a habit in school life, and the teacher's authority must never be questioned; his conduct should be so consistent as to inspire respect and confidence, and so correct as to be worthy of imitation. Some may be 'born to command,' yet

'Every one may acquire the power of ruling others by steadily setting himself to do so, by thinking well over his orders before he gives them, by giving them without faltering or equivocation, by obeying them himself, by determining in every case, and at whatever cost, to see them obeyed, and, above all, by taking care that they are reasonable and right, and properly adapted to the nature of childhood, to its weakness and its needs.'

Recreations, prizes, and punishments are discussed at some length, and certain theories refuted. With regard to punishments, the lecturer insists that they should be inflicted in such a manner that the child shall not be 'conscious of injustice.' 'Corporal punishment,' against which so many unpractical sentimentalists declaim, he does not denounce, but, nevertheless, asserts 'that it is almost wholly unnecessary, that it does more harm than good, and that in just the proportion in which teachers understand their business they will learn to dispense with it.' We agree with this, and believe that a *perfect* teacher will not need to use the birch.

'If your government is felt to be based on high principles, to be vigilant and entirely just, to be strict without being severe, to have no element of caprice or fitfulness in it; if the public opinion of the school is so formed, that a scholar is unpopular who does wrong, you will find not only that all the more degrading forms of personal chastisement are unnecessary, but that the need of punishment in any form will steadily disappear.'

A senior wrangler is not necessarily a good head master. Disciplinary power depends more on character than on culture.

The fifth lecture points out the conditions of 'remembering' what is learnt, and the principles which should determine the kind of lesson with which the memory should be taxed. The interest usually excited by oral lessons commends this form of instruction, and when the teacher has 'fluency, fertility, and quickness of resource, care in the choice of his language and a *lucidus ordo* in his arrangement, a power of putting the same truth in several different lights, a quick insight in discovering the difficulties in the learner's mind and in removing each difficulty when it occurs,' qualities which, with 'a certain tact,' are indispensable, there is, in our opinion, no mode so effective in permanent result on the mind of the pupil. The collective lesson skilfully given is the most valuable and efficient instrument at the command of the 'practical teacher' for true educational purposes. Suggestions as to bookwork and home exercises close this chapter. As might be expected, Mr. Fitch insists on the cultivation of the *rational* memory in preference to, but not to the neglect of, the *verbal* memory. He shows, for example, the little value of *beginning* grammar by learning the definitions. We once heard a distinguished French educationist say in accordance with this opinion: 'Commencer par la définition, c'est commencer la maison par le toit; la définition, c'est le sommet de la science.' The uselessness of 'learning by heart' answers in 'catechisms,' and of other similar 'memoriter' work, is made manifest in passages of merciless and merited vigour.

The lecture on Examining includes the 'Art of Questioning.' Who reaches perfection in this art has but little to learn. Principles and methods are indicated which, fully carried out in practice, will save both teacher and pupils a vast amount of trouble. Interrogation discovers difficulties, and may often lead to a rational perception of truth. This is illustrated at length in a Socratic dialogue. We do not find, however, any notice of the elliptical method of interrogation, one which is most useful with all children who have a limited command of language. Some wise cautions are given with regard to marking written exercises, but in these days when we are visited by an 'examination epidemic,' it is difficult for all teachers to act on the maxim: 'Take care of everything but the examination, and let the examination take care of itself.'

Preparatory Training is the title of the seventh lecture, and reviews the methods adopted in teaching writing, reading, and spelling. We sympathise with Mr. Fitch in a kindly regard for the Kindergarten.

'Experience shews that children who have been disciplined on this system, are found (1) to have got the rudiments of writing, counting and drawing, and to be better prepared for the ordinary subjects of school instruction than others; and (2) to have obtained in an indirect way a good deal of useful training which shews itself in quickened sensibility and prompter intelligence!'

The principles of the system should be more fully recognised by those who 'examine' our infant schools. The new proposals of Mr. Mundella seem to indicate some relief to the pressure now put upon the 'little ones,' and we trust that the joy of infant life will not be banished by any code from our public elementary schools.

The Teacher's Manual of Exercises in Mental Arithmetic. By Henry Hopkins, A.M., Ph.D. 245 pp. London: Simpkin, Marshall and Co.

This work, which is now in the third edition, is one which, on the face of it, bears evidence of a prodigious amount of painstaking labour and minute accuracy. Twenty-five thousand questions are propounded, and answers given to each. We have taken the trouble to verify some hundred or so of these answers, selected almost at random, and have as yet failed to meet with any mistakes. This gives a fair presumption that there really are very few indeed, if any, in the whole book.

The importance of Mental Arithmetic has, we humbly think, been both undervalued and overvalued; undervalued by those who scarcely teach the science orally, overvalued by those who, like our author, teach it to an excess, with the inevitable result of making calculating machines out of intelligent beings. Of the two courses, very probably the former is the more culpable. Parents meaning their sons and daughters to receive an elementary education only, do not as a rule desire more arithmetic and mathematics generally to be taught than will well fit them to avoid being cheated by the butcher or the draper. But this is, unfortunately, precisely the point where our young ladies' 'seminaries,' and some few boys' schools fail. We have ourselves seen housewives, who have newly acquired the dignity, pull out pencil and paper or memoranda tablets to reckon the amount of their bills, which, meanwhile, the shop-girl has done before the pencil makes its appearance. Or, if other evidence is required, turn to their account books and notice what an immense sum occurs in the column of 'items,' which, in most cases, may be more accurately described as unaccountable pence.

Any one who has had any experience in teaching will confirm this. For such an one's benefit we will add the further proposition—which, perhaps, he will be less ready to endorse—that he, as a teacher, too often assumes that previous teachers have done the necessary as far as mental arithmetic is concerned, which assumption has a result similar to the one in the well-known tale where the members of the synagogue resolved to present a cask of red wine to their new rabbi, each one to bring a pint of wine to fill it; and each one resolved to pour in water for his share, trusting that one pint of water would not be noticed in the midst of the thousand of wine. Judge of the rabbi's feelings on drawing a bumper of his congregation's munificent present. Judge also of the great, blank, staring white wall in the mind of the innocent upon whom this system of education has been practised.

This stricture does not apply to our elementary board schools, but we fear that our second stricture does, and with greater force. In them, perhaps, the study is overdone. Its advocates talk grandly about its sharpening the wits, and doing many other marvellous things. So, to a certain extent, it does, but to a certain extent only. A grindstone sharpens a chisel in a minute, but if you turn the grindstone till your arms ache your chisel will be no sharper than at the end of the first minute, probably blunter. Poor calculating Bidder was an idiot and a dunce when you set him to Latin. No good mathematician can work an arithmetical problem mentally, with speed and simultaneous correctness. And medical authority will bear us out in stating that there are sums which you can easily do on paper, but which will injure a child if you set them to him to do in his head. Some of these, we believe, occur in this book, and yet we have the author's word that he has or has had pupils who can do them all. To find the value, for instance, of *factorial sixteen, i.e.*, the continued product of 16 and all numbers less than 16, namely 20,922,789,888,000. Any boy who could do a sum of this sort in his head we should deem happier if some fairy wand could turn him into brass and figures and make a Babbage's machine out of him.

Or again, a titanic rule is given for finding the day of the week from the day of the month and the year. In the first place we have to find what our author calls the 'anticipation.' This might have been equally suitably called a hippopotamus, but that is a mere detail:—

'The anticipation is thus found: For the present century subtract 1820, 1848, or 1876 from the number of the year, according as it may be nearest above one or other of these numbers. To the remainder add its fourth part, omitting fractions. Reject the complete sevens from this total, and the remainder is the anticipation for the year.'

This learnt, and it is neither hard nor impracticable, we hear that the anticipation is the day of the week on which the month of September ends. We have now a series of numbers to commit to memory:—

Common year	0	3	3	6	1	4	6	2	5	0	3	5
Leap year	6	2	3	6	1	4	6	2	5	0	3	5

These numbers refer to the successive months of the year, and are baptized 'menstrual augments.' Thus 0 and 6 are the peculiar property of January, and so on. This table is not hard, at least not very hard to commit to memory. Now we are ready for the *finale*:

'Add together the anticipation for the year, the menstrual augment, and the number of the day of the month, reject the complete sevens, and the remainder indicates the day of the week, Sunday being the first.'

To commit such a rule to memory is, we think, the height of folly, considering that there are few circumstances where a reference to *Whittaker* could not be made more easily. Besides this, the table is unnecessarily complex. As it stands, the rule will not help us in the seventeenth century, and the adaptation which Dr. Hopkins makes for this emergency becomes simply hideous when applied to the seventh century. Why not say that the anticipation for any year whatsoever, a millennium hence as well as now, is the remainder, after dividing five-fourths of the year by seven? This seems simpler, and is easier in practice.

But by thus choosing particular examples we fear we have scarcely conveyed our appreciation of the author's merits. The book is on wretched paper, only fit for wrapping sugar; but this is not his fault. His part of the work is well done, and the publisher's part is well protected from the eye of the purchaser by a strong and serviceable binding.

We conclude by heartily commending this book to the teacher. We wish it all success.

Matriculation Questions on History and Geography, from 1844 to 1881. Collected and arranged by F. W. Levander, F.R.A.S. 155 pp. London: H. K. Lewis, 1881.

This little book at once prepossesses us in its favour by the extreme neatness of type, paper, and binding. In fact, it is by far the most pleasing specimen in this way that we have met for some time. And the author has the additional advantage that the subject-matter also is quite free from blame, or rather that the blame, if there be any, must fall not on him, but on the examiners of the London University. We have one objection only and may then dismiss this part of our task entirely. The classification

adopted for the questions in English history seems to us to be to a great extent frivolous and arbitrary. Firstly, we have the vague term, 'Principal Events,' which might mean anything, from the death of King Charles' spaniel to the wine-tub episode in which Clarence took such an unfortunate part. And then again, 'Succession,' which, we think, would far more aptly have come after, if not along with 'Ethnology and Genealogy,' which two latter subjects, by the bye, are no more intimately connected than Botany and Chemistry. Again this classification principle leads us very wrong when we come to Roman and Grecian History and Geography. Here we find questions asking us to write a commentary on the historical accuracy of passages quoted, or demanding a minute acquaintance with a historical point which the general reader would pass by and almost forget. The opinion a novice would form from this is that the matriculation is a remarkably hard examination and demands a vast and varied store of historical learning. But the fact is that these questions (in Roman and Grecian History) all have reference to the special subjects which had been previously given for the candidates' preparation and are therefore not half so difficult as at first sight they would appear to be. This fact should at least have been stated.

We advise the author, if a further edition is called for, to print wholesale and without alteration the papers as they were set at the actual examination. They would then be far more useful to the matriculation student, for whom, we suppose, they are chiefly intended, and quite as useful, if not more so, to the problem-lacking teacher, to whom, perhaps, they are subsidiarily directed.

The matriculation is an examination which, more than any other, demands thorough work and untiring application to wearisome details. It is the only one, so far as we know, in which the places are determined not by absolute marks but by absolute merit. Its Second Division is chiefly composed of men, the aggregate of whose marks would have placed them far above most in the first division, but who showed a culpable weakness in some one subject or a uniform mediocrity in the whole. On the other hand, its Honours Division is composed of a strange mixture of brilliant talent and dull-headed hard work, and often the latter will predominate. Ten marks out of a total of 2,800 will sometimes make a difference of two or three places in the Division List; so that, among the first few, the value of a single mark may be £5.

This being the case, a process near akin to 'cramming' is excusable, though, some will say, not advisable. And it is this process which we should tell any one who works for position merely to adopt; namely, a painstaking study of the papers of past years, so as to have at one's fingers' ends all the little hobbies of the examiners, and be able to foresee to a certain extent what questions would be set

That this process will pay we have no doubt. Equally little do we doubt that it is harmful and may fail of itself. Still a combination of the two is certain of success, and this, we believe, is the only true method of working for any examination. Do the subjects thoroughly, know every point, and then, not before, study the papers of past years so as to know on what to lay particular emphasis. This knowledge attained, be careful to keep the whole in mind and the candidate is well equipped.

Anyone who will conscientiously follow out this plan will find any compilation of questions, such as this, invaluable. Anyone who, having got these questions in his head imagines that he may on this account work one iota the less, is making a grievous mistake and had better have left them alone.

With these observations we commend the book to the reader. Mr. Lewis would do a great service if he were to reprint other papers—say those on English, Latin, and Greek Grammar.

Algebraic Factors: How to Find Them, and How to Use Them. By W. T. Knight, F.S.Sc. 80 pp. London: Blackie.

This work is an attempt to throw light upon a gloomy nook in Algebra. 'As a rule, this branch of the subject is hurried over with but a slight notice, both in books and in the schoolroom. Nothing could be more injudicious, since a true conception of factorial analysis enables the student to traverse with the greatest ease branches of Algebra which in other cases prove veritable Sloughs of Despond.'

No one can deny that Mr. Knight's intention was admirable, or that a book on the subject is very necessary. At the same time, we have several indictments to prefer against its execution, which we regard as more or less serious.

And at the very commencement we may give our opinion that our author and all subsequent authors on this subject would do well to adopt the newest notation which discriminates between '*is identically equal to*' and '*is, for a particular value, equal to*,' giving three horizontal strokes to the former, and only two to the latter. Thus we write—$(a-b)\times(a+b) \equiv a^2-b^2$; but an equation thus—$x^2-ax+b=0$. It is true that this alteration would at first present a little difficulty to the learner, but it is also true that it would render many passages in our modern text-books perfectly clear from being quite hieroglyphical, and would allow most average students to reach the meaning of a mathematical author without the aid of an expositor—a thing which is at present visionary to the uninitiated.

Since the sign '*is identically equal to*,' is also used as signifying '*is equivalent to*,' or 'may be replaced by,' we should often escape being plunged into confusion by the carelessness of an author. As, for instance, when Mr. Knight tells us, on p. 11—

'Here $a^3=8a^3\ b^3c^3$, $b^3=x^3$; hence $a=2ab^2c^3$, $b=x$, etc.' In this example, one only out of many, it takes any one who has not read the previous pages, an effort to see what on earth those mystical equations mean. He reasons thus—'$a^3=8a^3\ b^6c^9$. $\therefore\ 2b^3c^3=1$. Q. E. D. And what good is it?' Whereas, of course, it should stand—'$a^3 \equiv 8a^3b^6c^9$, *i.e.*, $8a^3b^6c^9$ *may be replaced* by a^3, and thus we may apply the formula for the factors of a^3+b^3, where $b^3 \equiv x^3$.'

Here there is no confusion, for it is well understood that in this significance of the sign cancelling is not allowable, nor is any algebraical operation except involution and evolution. Our first complaint about the book is that it is unnecessarily cumbrous. The theory of quadratic equations should have come first, and then the application to the factors of quadratic expressions. Mr. Knight's order cannot but lead the student wrong. He sees that x^2+2x+1, x^2+3x+2, x^2+2x, etc., all split up into real factors, and the poor fellow is sure to waste much time and bother a muddledom of a head to split up x^2+2x+2, or x^2+3x+1. All difficulties of this sort would be met by the reverse order. Besides all this, let the reader only turn to p. 19, where the unfortunate is initiated into the art of guessing factors of an expression such as $24x^2+46xy+21y^2$. After this, if he does not sigh for the friendship for quadratics, we are much mistaken.

A more serious charge is the next. Unconsciously Mr. Knight deprives the student of the power to think for himself by not giving him sufficient opportunity to exercise it. It is a mere piece of padding to repeat a formula already enforced, unchanged save by the alteration in sign of some member. Given any formula you please, the learner should be trained to deduce in his head, without writing it down on paper, the corresponding one formed by alteration of signs. Once known that $a^3+b^3+c^3-3abc = (a+b+c)(a^2+b^2+c^2-ab-ac-bc)$. We do not need to be told, as we are on p. 29, the factors of $a^3-b^3-c^3-3abc$, $a^3+b^3-c^3+3abc$, $a^3-b^3+c^3+3abc$. Surely it would have required no great genius to educe the last, at any rate, from the one preceding it—not to mention the rest.

There are many more complaints which we intended to have made, but we are compelled by space to make them merely in the form of suggestions:—

(1) The following rule should scarcely have been omitted or condensed to the comparatively useless form in which it appears on p. 24:—

'If F (*x*) is divided by $x-a$, the remainder is F (*a*), so that if F (*a*) = 0, $x-a$ is a factor of F (*x*).'

It is invaluable, as Mr. Knight must know, in complex factorial simplifications.

(2) The factors of the following expressions should have been more fully dealt with, each having some special importance :—

(α) $2a^2b^2+2b^2c^2+2c^2a^2-a^4-b^4-c^4$

(β) $a^3+b^3+c^3-3abc$.

We must now conclude. It requires either sublime genius or sublime luck to write a perfect mathematical book. About Mr. Knight's, all we feel justified in saying is, that it is far better than its predecessors, which latter compliment should be discounted by the fact that we do not remember having seen any predecessors.

Inorganic Chemistry, Theoretical and Practical. By William Jago, F.C.S. 202 pp. London: Longmans, Green, and Co. 1881.

Mr. Jago would seem to us, judging, at all events, from his preface, to be labouring under feelings rather inimical to the South Kensington Chemical Notation. We wish he had expressed these feelings a little more strongly, for notwithstanding his slight hint of dislike, we have still the eyesores of inconsistency which, in spite of all its evident merits, render the system worse than useless to some, and a very great hindrance to others. Notably among these eyesores is the occurrence of atomic instead of molecular symbols in equations. This is mentioned, indeed, on p. 95, but so far on in the work that it may be doubted whether the student will be able to revolutionise his ideas before he reaches the end. As a molecule is the smallest portion of a body capable of independent existence, and as all the molecules of the elementary gases contain two atoms, such an equation as

$$Hg+O=HgO$$

is nonsense, because the second symbol of the sinister cannot exist. It should, of course, be—

$$2Hg+O_2=2HgO\ ;$$

not Hg_2, because mercury, zinc, and cadmium would seem to have only one atom in each molecule.

Here it is that the inconsistency of some of the men of the South Kensington School comes in. They rigidly adhere to this law for gases, but, for a reason known only to themselves, treat it with disdain when solids are concerned, and allow such equations as—

$$3Fe+2O_2=Fe_3O_4, \text{ or}$$
$$Fe_2+2O_2=Fe_2O_4.$$

Thus, to take a glaring example from a Matriculation paper,

$$H_2S+O_3=H_2O+SO_2$$

is said to represent the combustion of sulphuretted hydrogen in air, as if the air must be converted into ozone first!

But we must turn to our author's book, and may at the outset confess that although we were humbly of the opinion that if any book was wanted in the world it was not one on the theory of chemistry, yet we like this as well as any of equally small pretensions that we have yet seen. The list of contents embraces the following :—O, H, H_2O, H_2O_2, Cl, HCl, C, CO, CO_2, N, NH_3, S, H_2S, H_2, SO_4, and the oxides of N and S. Of course this list needs considerable alteration before the book can ever become a *vade mecum* for London examinations. It is also absurd to assign five pages to hydroxyl, while there is no mention of marsh gas or phosphorus. And, too, it is doubtful whether the science of chemistry—the firm principles, we mean, on which it rests—can ever be taught accurately by types selected in such an arbitrary fashion as this. But these charges lie at the door of the imperturbable geniuses at Kensington, not of Mr. Jago, and we may dismiss them with a mere mention.

The main feature of the book is its adaptation to laboratory work, in the first place by a series of numbered experiments introduced into the text, and to be performed by the student; in the second place by what are called 'Laboratory Hints,' appended to each chapter. The first plan, of course, is a not very new one; the second, in its present shape, we have not seen before. The hints are, of course, not quite perfect—here and there, in fact, absolutely faulty; still, they will do a good deal towards enabling private students to initiate themselves into the details of chemical manipulation.

The summaries are very lame performances. Our author needs to be reminded that in science a summary is rarely valuable to the student unless he makes it himself.

The standard attained throughout the book is much the same as that of Miller's 'Introduction to Chemistry,' published in Longmans' Science Series, rarely lower, and in the theoretical part much higher. In this latter Mr. Tilden's little manual has confessedly been largely used.

For its own purpose, Science and Art Examinations, we welcome this effort as a vast improvement in type, arrangement, and contents to its predecessors in the field.

French Nouns and their Genders, with a Complete Vocabulary of Exceptions to the Rules. By Thomas Goodman, assisted by MM. J. Ferrier and Alf. Hamonet. 64 pp. London: Simpkin

Our complaint against this book is that it is too complete, too extensive for any Englishman to be able to master it without spending more time upon the study than the French language as a whole is worth. It is nicely printed, and would form a very useful manual for reference if it were only decently bound. But to expect any man in his senses to learn it is to expect a sheer impossibility. The work is divided into four Sections—I. On Particular Nouns. II. On Class Nouns. III. On General Nouns. IV. This last is a farrago of various matters which either have or have not any connection with the genders of nouns or with nouns at all. We will examine the book in the order of these sections.

Section I. is made up of a 'List of Nouns which are Masculine in certain Significations, and Feminine in others.' This list contains 113 words, and will thus necessitate learning what is equivalent to almost 500 different significations. How formidable this looks; and yet what are the facts of the case? That about forty of these are important, and nearly forty wholly unimportant, rarely heard in ordinary conversation, and such that if met with in books, the context would at once declare the meaning.

Section II. is composed of general rules. Of these we observe that five or six, at least, look suspiciously like mere padding, as, for instance, on the first page, where six rules might certainly have been condensed into one. In this section comes a table of 'The Various Appellations of the Principal Animals, and their Young,' which for reference might be very useful, but which it is preposterous to expect to commit to memory. In the list of exceptions to the rule that 'Trees, Shrubs, and Bushes are masculine,' we notice several omissions, notably *ébène* and *viorne*. In the next rule, *Theiss*, *Tweed*, and *Neiss* are omitted, besides at least half-a-dozen rivers whose names end in *a*. *Mousson* is omitted from Rule 13. Rule 14 might have been shortened to :—'Names of Mountains are Masculine, except names which are plural in form.'

But it is useless to go on complaining about geographical genders. If the French discover anything new in the world they seem to toss up for its gender, and for aught we know, Mr. Goodman may have persuaded a French author to make *Tweed*, for instance, masculine in his book, and thus sanction a perpetual usage. It is the merest truism to say that this branch of genders are in a simply ridiculous state. When rules proclaiming that distant countries are one gender and near countries another are given to their pupils by French masters apparently in their senses, we need no further accusation against the language.

And so we might struggle on with Section II., but let us leave it for new pastures. At Section III. we confess

we were horrified. The average number of exceptions to the various rules is about fifty. Now and then, by way of variety, Mr. Goodman will double this number. Out of forty-one rules, throughout orthographical and not determined by meaning, only seven are blessed with no exceptions, while the last of the forty-one, which may inspire affection because it is the last, has the small sum of 150 exceptions. Thus, we are not far wrong when we say, guessing roughly, that the total number of exceptions, all to be committed to memory, falls little short of a thousand. Notwithstanding this, *not more than* 300 nouns are used in the conversation of ordinary people, so that we cannot but think it a work of supererogation to learn off all this titanic collection of forty-one rules and a thousand and one exceptions.

We have not, we confess, read this section throughout, for we almost shrunk from looking at it, so that we cannot say whether it is complete or not. For our unfortunate student's sake we may hope that there are no more additions to be made.

Section IV. is in no sense novel, and may be dismissed without further mention.

We are sorry that we cannot speak more favourably of a work which must have demanded a vast amount of care, attention, and time. 'Seven years' laborious research' seem to us seven years nearly wasted, likely, at any rate, to produce very little fruit. 'The means of acquiring, with hitherto unknown rapidity, an accurate and ready knowledge of the genders of nouns of the French language,' are, we think, still undiscovered, and taking into account the fact that not half the French nation itself, even the educated classes, knows its nouns thoroughly, these means are possibly undiscoverable. That this book 'will be found singularly useful as a *vade mecum* for the desk of the correspondent or the pocket of the tourist,' is a hope which can never be realised, because any good dictionary will do thirty times as well.

We will conclude by suggesting that the only true method for teaching French genders, is the same as that adopted for teaching German, to learn the article with each word. It cannot be otherwise when the whim of an ignorant set of Latin soldiery has reversed the fate of many of the words which might otherwise have had a chance of reaching France undefiled.

Primer of Industrial Geography of Great Britain and Ireland. By G. Phillips Bevan, F.G.S., F.S.S. 109 pp., 2nd. ed. London: Sonnenschein and Allen, 1880.

We always have very great sympathy with any undertaking of this sort, and are glad now to notice that Mr. Bevan's useful little manual has reached a second edition.

Geography, more than any other subject, is at the present day outrageously mistaught. Your average teacher will, book in hand, instil into the more or less miserable urchins around him name after name of obscure cape or unintelligible tribe, which it is as little likely that said urchins will ever in their lives come across, though they travel from pole to pole, as it is likely that they will explore and map out the gulfs and inlets of the bed of the mid-Atlantic. Of course, it is very pleasing and interesting, and all that sort of feminine thing, to know that Everest is the highest mountain in the world, or that Guadalquivir is not in the Friendly Islands, that crossing the line does not mean running over a rope, or that it is not true, though the Editor of the *Manchester Courier* says it is, that the South Pole is hot, because it always does get hotter as you go further south. But, at the same time, we affirm that it is infinitely more important to know where you change in any common railway journey, or in how many ways you can get from Newmarket to Liverpool, say. And it is just this branch of geography that is systematically neglected. One reason, and, in its way, a fairly good one, is that teachers themselves don't know it. Of course, in that case, the wiser course is not to teach it. Still, there is no excuse for their ignorance. It is really pitiably comical to go any ordinary railway journey and unobtrusively to inquire the destinations of your fellow passengers. Suppose we try from Bristol to Derby, by the fast express. An old gentleman seated just opposite is going to London via Birmingham, and may arrive within five hours of the time when the Great Western would have taken him. At Mangotsfield another gets out and changes for Bath, intending at Bath to change to the Midland and South Western Joint for Templecombe, eventually to land at Exeter. The 'Flying Dutchman' meanwhile does it from Bristol in half the time. We do not stop at Gloucester, and at Cheltenham there are sure to be half a dozen who meant to get out at Gloucester, preferring that way to South Wales, to crossing the Channel at Newpassage and Portskewet. And so we might continue. These are not ideal cases. We have seen specimens of each. We do not hesitate to say that they are of daily occurrence.

Not less extensive, though, perhaps, less culpable, is the ignorance of the great trunk roads of England. Put a man on a bicycle, give him no map, allow him merely to ask the names of the villages through which he passes, set him off at London and tell him that you will meet him at York. You may smile as grimly as you like, but except your man is one in ten thousand, you will as probably find him at Exeter, or Southampton, or Margate, as at York.

Really, it is a serious matter when the little children out in New Zealand know the geography of England better than those who are brought up in its village-schools.

Closely linked with this is the 'Industrial Geography of Great Britain,' and it is for the reasons that we have just been explaining that we accord a hearty welcome to Mr. Bevan, and only wish he had made his book bigger. We hope that our author, if he do not see fit to adopt our recommendation in this, will at any rate some time or other find his way clear to publishing a little manual of the railways of Great Britain, which may consist of an expanded edition of the neat little summary in Chapter ix.

We have left ourselves space to say but little about the workmanship of the book, and all that little is congratulatory. The get-up is extremely neat, and the contents interesting always, rarely tabular, but never on that account shallow. All success to any venture which, by making prominent the geography of England, annihilates the absurd and utterly pernicious theory that to know the position of Denver City, or any conceited little shanty which, great or small, calls itself a city and has not learnt to build of stone, is more important than to know your way from the Marble Arch to the Bank, or through the mazes of New Street Station.

Pictorial Atlas of Nature. London: Ward and Lock.

This attractive book is one of the best aids to Geography that can be met with. Of course we here speak of Geography in a very different sense from the mere collection of names of places associated with—more or less understood marks on maps. These latter have their uses, and cannot be dispensed with, but the knowledge of the people, plants and animals, and other productions of different countries, together with physical features, have in too many cases been thrust aside, as forming useful reading about geography, but not indispensable to the science itself. Happily these so-called accessories are now being justly regarded as the most important features of geography, and taking this view Messrs. Ward and Lock have done great service in the very attractive book before us. The illustrations constitute a leading feature of this book, and are carried out with uniformity of plan that contrasts favourably with the mere collections of wood engravings that are often thrust forward to do duty over and over again in all sorts of books and on all sorts of subjects. Here we have systematic pictorial representations of the types of the people of the earth or families of the human race as they are distributed over the various regions of the earth, with accompanying descriptions.

These are followed by similar representations with explanatory text of *Animals*, and next of Plant Life. These are variously grouped in separate chapters relating to Europe, Asia, Africa, North and South America, and lastly of Australia. The collection has been taken from a large mass of material, and has been thus collected with care and judgment. No less than 500 well-executed wood engravings form the illustrative portion of this admirable volume, and these are accompanied by terse and accurate explanations, together with maps carefully figured to exemplify the references in the text. Illustrations, maps, and text are all presented together on one sheet, whereby the trouble of turning over for frequent reference is avoided and on this plan not evaded. Few books will be found so useful to the student, and at the same time so attractive to young people.

Notes on Exodus. For the help of Bible Students. Laurie's Kensington Series. London: Thomas Laurie. Stationers' Hall Court.

When we mention that Mr. Fleming, the author of these notes, has laid the best modern authorities under contribution, including the learned Hebrew, Dr. Kalish, we say sufficient to show the value of this little book. It is of course limited to explanatory features to the avoidance of controversial topics. The most salient points of the dispute, how much of the book of Exodus (the *Shemoste* of the Hebrews) was written by Moses, and what additions were made by Ezra and his fellow scribes or compilers is briefly and fairly stated. The main portion of this book consists of explanatory notes and verbal elucidations, which are clear and to the purpose. A brief analysis, followed by a general index, completes the little volume. The 'ark of bulrushes' in which the infant Moses was committed to the river is thus described:—'An *ark* or chest of *bulrushes*, *i.e.*, of the papyrus, which was formerly used in Egypt for light boats. It does not now grow in Egypt. It is a strong rush, like the bamboo, about the thickness of a finger, not quite cylindrical, but three cornered, and attains the height of ten to fifteen feet.' The direction given to Moses to put off his shoes is explained from Kalish as an act of courteous reverence similar to the uncovering of the head by western nations. The facility by which the eastern shoe could be removed by the mere untying of the sandal, should be remembered in this explanation. No one will question the gain in the thorough understanding of the sacred writings by profound scholarship, aided by an extensive knowledge of Eastern manners and customs. Every year adds to this fund of information, and the book before us places such investigations at the use of the humblest student.

A School Physical and Descriptive Geography. By Keith Johnston. London: Edward Stanford, Charing Cross.

This valuable work must take a leading place among modern school geographies. The name of Keith Johnston is sufficient to claim attention to its pages, and the care and completeness of the work itself fully justifies the high opinion held of the author's reputation as the most able exponent of geographical information. The book before us—though an abridgment of the author's larger work—occupies upwards of 400 closely, though clearly and excellently-printed, pages. This abridgment is mainly formed by the omission of most of the historical features of the larger geography, together with most of the elaborate maps. Of these latter illustrative aids, the work before us contains a fair portion, though less than we could desire, from the valuable collection available that form part of the larger work.

The compendium before us will be especially valuable to students and pupil-teachers. Its style is more advanced than that of ordinary class-books on geography, and its information more extensive than lying within the scope of junior classes. This is a merit, considering the capabilities of those for whom this book is designed. By a thoughtful study of its pages, pupil-teachers will be able to pass their examination with credit.

The physical portion occupies as usual the first portion of this book, and has a capital introductory chapter on the formation of maps and plans from observation made in rural walks. The points of the compass, and invariably of the polar star, are here clearly shown. This is followed by a capital exercise for the formation of rough maps from descriptive notes. This kind of work will, we trust, become much more common. The astronomical portion is treated with remarkable clearness, as also the circulation of the air and waters. The tides, however, are dismissed in less than a dozen lines, with the remark that 'it is only along the immediate shore that the tidal undulation is converted by the opposing land into an actual forward or sideward movement of the water. The tides play but a very insignificant part in the movements or interchange of the waters, and have no appreciable influence in modifying the climate of any part of the globe.' Very true, but the tides have a considerable influence in modifying or changing the contour of almost every coast-line, and should not be cursorily dismissed, though of no influence in regulating climate.

In the Descriptive Geography, the author wisely introduces the outlines of the physical features of each of the great divisions of the globe. These are relieved from dulness by such lively and suggestive remarks as the following:—'Throughout the summer the table-lands of Castile, bare and treeless, are burned up by the hot sun, but through the chilly winter they are swept by violent winds. The herdsman, who wears a broad-brimmed hat for protection against the excessive heat during the day, a few hours later puts on his thick, warm cloak; in the same way, after the almost summer, follows a cold winter, with ice and snow.'

In speaking of the inhabitants of England, the author does not repeat the exploded theory of the Britons being exterminated by the invading Jutes, Angles, and Saxons, but wisely remarks—'Thus the population of the British islands is a mixed Celtic, Germanic, and Romanic one, all its elements being more thoroughly amalgamated in the populous lowlands of Britain, the Celtic remaining purer in the highland regions, which are more difficult of access. In Ireland the Teutonic element prevails along the eastern margin; thence toward the western mountains the transition is gradual to the pure Celtic.' In regard to education, many would demur to the remark that 'the manufacturing and mining portions of England are lower in the educational scale than the agricultural.' Generally speaking, the political portion of this geography is treated less extensively, though far more readable, than in most other books of the same character. Indeed, throughout, the book is thoroughly readable, and not disfigured by dry columns of names and figures. The derivation of the most important names is given in footnotes, together with more ancient names in many cases, as, for instance, Cale (or Cales), the ancient name of Oporto, and thus arose *Portugal*, from *Portus Cales*, the name of the whole country. Speaking of the people of Lisbon, the author says: 'Unlike Madrid, where everyone is Spanish, the cosmopolitan port of Lisbon is thronged with white and negro, English clerks, bearded Jews, and weather-beaten sailors of all nationalities. Oporto is busiest in sending the wine of the Douro valley to England.' In such lively fashion does the author carry us with him through his instructive pages. The wretched state of popular education in Italy is very properly alluded to by Mr. Johnston, and the efforts now made for its improvement by means of the funds obtained from useless monastic establishments.

We might go on adding quotations of well-written passages, in which new truths are expressed or old ones happily uttered, did space permit. Altogether this book cannot fail of making its way and doing much to elevate the teaching of geography from its former dry and undignified position. A good index forms a necessary feature at the end of the book.

Examination Arithmetic. Fcap. 8vo. 158 pp. **Key to Examination Arithmetic.** Cr. 8vo. 274 pp. By T. S. Harvey. London: Blackie and Sons, Old Bailey.

We are always glad to see schoolbooks penned by experienced and successful teachers. The one before us—designed primarily as a coach for examinations—reveals on almost every page the hand of the practised craftsman. In this admirable volume Mr. Harvey has collected and arranged in a graduated form, over twelve hundred arithmetical questions culled from the Oxford and Cambridge, College of Preceptors', pupil teachers', scholarship and certificate papers, thus furnishing a most excellent examination course. To head-masters who set periodical tests, and to the private student anxious to figure well on the list it will be invaluable. The key, which contains the full working of the sums, has the additional merit of showing how the problems should be set down on an examination paper. We have no hesitation in saying that of all the examination arithmetics which have come under our notice—and they are not a few—this is by far the best.

The Messrs. Blackie have sent forth these two books in the same faultless manner as the various volumes in their now well-known comprehensive series.

Bemrose's Standard Arithmetics, for Standards 1, 2, 3, 4. London: Bemrose and Sons, Old Bailey, E.C.

On the title-page of these neat-looking little books we are informed that they are 'adapted for teaching and testing.' Mr. Maxlow, the compiler of these arithmetics, has done his work in a highly creditable manner. They contain a vast number of exercises, many of which—wisely, we think—overstep the bare requirements of the code. At the end of each book a capital selection of 'Miscellaneous' questions is given. A child who works through these sums, and can 'do' them 'right,' need fear no examination of a reasonable inspector. The answers to the four parts are issued in one book.

PRIZE BOOKS (First Notice).

School Days in Paris. By Margaret S. Jeune. London: Griffith and Farran, St. Paul's Churchyard.

We place this at the head of a batch of attractive books that gladden the eyes of many boys and girls at the Christmas holidays. Very many of these reward books remain unread on drawing-room tables on account of their being either too sermonising, too dull, and in not a few instances too childish. We rejoice that in most of the little volumes before us these faults are avoided, while the morbid sensationalism of cheap trash is as sedulously shunned. To interest and amuse without appearing to instruct and moralise is by no means an easy task, but which, nevertheless, has been admirably exemplified by many writers, from Mrs. Hofland down to the late Mr. Kingston. Of this juvenile literature the names of Griffith and Farran worthily occupy the place of their renowned predecessor, Mr. Newbery. In addition to the attractions of the literature and illustrations, the pretty covers of several of the books before us are by no means to be lightly esteemed. Branches of trees with twigs bearing silver cherries and sprays bearing equally attractive flowers form the designs of several of Messrs. Griffith and Farran's pleasing volumes. The author of 'School Days in Paris' is less amusing than descriptive, but very readable from his plain truthfulness. The fare, if we may take this as an example of French school diet, was by no means attractive, indeed we should say scarcely nourishing. 'Our fare was very simple, and although well cooked, not prepared *à la* anything to be found in Soyer. Our breakfast, at half-past seven (we got up at five in summer and six in winter), consisted of vegetable soup, sour bread without butter, and water. At twelve o'clock came the second *dejeûner*, when the usual fare was potatoes and carrots boiled together, red or white cabbage, lentils, in the season large dishes of peas and asparagus, or occasionally cold meat served with oil. *Eau rougie* was our beverage; that is to say, water with just enough wine in it to change the colour. At five o'clock we dined on soup *bouilli*, sometimes a roti, vegetables and a dessert of bread and preserves. This ended our meals for the day, for tea was unknown, except on Thursday evening, our half holiday—tea, at least we called it, though its claim was very doubtful. However, it was warm and sweet and comforting, although sent up in a tin can.' This is not very attractive, and we believe much of the physical weakness of girls is owing to insufficiency of generous diet. Speaking of the custom of husbands being selected by parents, the following remarks will at least amuse if not furnish material for reflection:—In French school-girl life there is an 'entire absence of the chattering confidences concerning supposed admiration, lovers, etc., which in even the best-regulated English schools forms the staple of English conversation of recreation hours.' The asserted absence of 'nonsense of this sort' is thus explained by one of the French pupils. 'What is the use of our troubling ourselves about such matters? Our parents' wisdom will do far better for us than we could do for ourselves. We know nothing of the husband selected for us, but neither do we know anything of any one else. With you English, being aware that your chance of marrying depends in a great measure upon your own powers of attraction, you therefore begin early to exercise them, and the subject exercises your thoughts continually, because the future is still all uncertain, and you never know when or where the future lover or husband will appear.' All this sounds plausible. It is, of course, far too prettily expressed to be taken *au pied du lettre;* but that may pass. It concerns all heads of schools, English or foreign, to check this asserted tendency in young ladies to be continually thinking and 'chattering' about marrying by providing sufficient mental occupation, relieved by judicious and cheerful employment, for leisure hours. The greater portion of these pages are much less argumentative, and contain lively pictures of French places and society. The book altogether is full of good honest fun, and the authoress possesses in no small degree an easy and graceful style, which, while often discursive, is never too colloquial.

Salt Water. By W. H. G. Kingston. London: Griffith and Farran.

Here we have another capital book about the sea and sailors by the lamented Mr. Kingston, who has done as much in making seafaring life popular among boys as Dibdin did in popularising the old naval service by his famous sea-songs. The hero of the tale was initiated into the details of a ship and its fittings by his faithful attendant, Larry Harrigan, whose early teaching did much to induce young D'Arcy to choose the sea for his profession. The lessons of Larry were brought into use at the outset of D'Arcy's career. The youth, finding himself in the company of some naval officers at Portsmouth, was twitted by them with being quite a novice in all things relating to the sea. The youth astonished his querists by his accurate knowledge of a ship and its rigging. His friend Larry accidentally discovered his long lost wife in the character of a lodging-house keeper at Portsmouth. From this happy commencement we are led through exciting scenes, involving hair-breadth escapes, and giving us striking pictures of sea life and adventure. The villain of the book, Bill Myers, pursues a career of crime as smuggler, pirate, and murderer for some time, till brought to bay by the hero, D'Arcy. Paralysed by the unexpected rencontre, Myers leaps overboard and becomes the prey of sharks. While the attractions of the sea are duly acknowledged, its dangers and trials are also pointed out. Whether our boys follow D'Arcy's example in becoming sailors or not we cannot of course determine, but we can assure them that they will read the book before us with unfeigned delight.

Our Birthdays. By Emma Davenport. London: Griffith and Farran.

This little book has a moral and religious tone. Lessons of improvement are given, mostly by way of narrative dialogue, interspersed with information on old illuminated books and other readable matter, together with a fair amount of incidents in the daily life of amiable and teachable children. The explanation of precepts from the book of Proverbs occupies a considerable portion of this little volume, but these explanations are given with judgment and a most kindly spirit.

Stolen Cherries. By Emilia M. Norris. London: Griffith and Farran.

This little tale describes the ill consequences of falsehoods to hide faults and accidents, whereby a downward course is continued until the consequences become very serious. A confession is then made and forgiveness bestowed upon the repentant boys instead of the expected punishment. Young readers cannot be otherwise than wholesomely impressed with tales of this kind.

Holidays Abroad. By Emma Davenport. London: Griffith and Farran.

Under the guise of holiday tours, this book fairly describes scenes in Paris and other places in France and also in Italy, with a sprinkling of incident and very much moralizing. 'Cousin Kate' talks in the goody and sententious style, which, though always instructive, is hardly sympathetic enough to be very attractive to children.

The Hero of Brittany. By Emile de Bonnechose. Translated by Margaret S. Jeune.

This book, as indicated above, is a translation of one of the histories of Emile de Bonnechose. The translator may be congratulated on the scholarly way in which she has done her work. Without departing too far from the original, she has succeeded in giving us a thoroughly readable and faithful translation. We have little doubt that the book will be eagerly read by many, who though unable to study the French original, would still enjoy reading the history of a period from a French historian's point of view. What portions of the life of Bertrand there are, which bear the stamp of improbability to us matter-of-fact people of the nineteenth century, may fairly be left to the judgment of the readers of this book, to retain or reject as they think fit.

The criticism of Monsieur de Bonnechose's book as a history does not at present concern us. He is well-known to the reading public as one of the most delightful of French historians. Apart from his theories, he has given us a most lively and picturesque view of the events of France at that time, and our thanks are due to Margaret Jeune for giving to the world so graceful a translation.

Cassell's French-English and English-French Dictionary. Crown 8vo. 1,122 pp. London: Cassell and Co., Ludgate Hill.

Probably some of our readers will smile at seeing a 'Dictionary' placed under the head of 'Prize Books.' Now that a fresh impetus is being given to the study of French, there must, however, be thousands of young teachers to whom this book would prove a veritable godsend as compared with a story-book, no matter how well written or beautifully illustrated it might be. So far as we know, it is without a rival, and a perfect marvel of cheapness. We strongly recommend this French dictionary as being well worthy of a place in every teacher's library.

Claudine; or, Humility the Basis of all the Virtues. By a Mother. London: Griffith and Farran.

The brilliant binding and pretty get-up of this little volume are only the exterior adjuncts of a tale which will prove highly interesting to all story-loving children. When we say that the work has reached its tenth edition, our readers will feel assured that it forms an admirable gift-book to a child fond of reading. The authoress evidently knows from experience how to provide mental food for children, and she has produced a work here which every child will be proud to keep in its own particular library. The plot is interesting, the characters are well drawn, and the moral is one which cannot be placed too often before the minds of young people.

Distant Homes; or, the Graham Family in New Zealand. By Mrs. J. E. Aylmer. London: Griffith and Farran.

The story written in the pages of this attractive and prettily-illustrated volume is of a family who were obliged, through financial difficulties, to leave their home in England and emigrate to a far distant land. We have a good account of their voyage to New Zealand, and a very faithful picture of the manners and customs of the aboriginal inhabitants of that country. There are one or two of those thrilling incidents which are generally to be found in stories of this description, and we can promise all those who take the book in hand that they will pass a very pleasant half-hour with Mrs. Aylmer.

Fickle Flora and her Seaside Friends. By Emma Davenport. London: Griffith and Farran.

Miss Davenport has produced a story of the stay of some little girls at the seaside which, we have no doubt, will be read with avidity in these long winter evenings by the children who so largely swell the population of our marine towns during the summer months. They will be reminded in reading these pages of the pleasant time they themselves passed during their annual stay by the great deep; while the little brothers and sisters who have not yet had an opportunity of catching tiny crabs and picking shells on the beach, will look forward with much anxiety and anticipation to the time when they will be able to do so. We could wish that the illustrations had been done in a little better style; but apart from this the book has no drawback, and we heartily recommend it to our readers.

Out on the Pampas. By G. A. Henty. London: Griffith and Farran.

In spite of the number of books there are of this class of literature, Mr. Henty has found something new to tell us in his interesting work. The novel idea of an English family, who, though in a good social position, can hardly contrive to make both ends meet, and therefore decide on emigration, is well worked out. We are soon settled with the family, so to speak, in their new home in South America. Their social life here, their various adventures in hunting, their troubles and trials are told with a charm of manner that reminds us of the works of the very best writers in this department of literature. Mr. Henty's characters too are pleasantly and clearly drawn, and his young ladies contrast most agreeably with the insipid portraits that it has been too often our hard fate to meet with in fiction. Mr. Henty takes us with him through a series of stirring adventures, which contributes in the highest degree to the success of the story, and keeps us in a constant state of curiosity as to what is going to happen next. To detail these adventures would not be fair. Suffice it to say that the story never becomes tedious, and by careful variation in the incidents, interest is kept up to the last.

ON THE BEACH.

Words by GEORGE BENNETT. *Music by* T. CRAMPTON.

Cheerfully. mf

1st TREBLE.
2nd TREBLE.
BASS.

1. Plea - sant 'tis a - long the strand, Turn - ing up the spark - ling sand; As the roll - ing
2. Now a - mong the rocks we pry, Weed - y nooks and cor - ners try; Laugh - ing, chat - ting,
3. Oh, the pret - ty fai - ry grot! No - thing in that qui - et spot, Where the wreaths of

KEY G. *Cheerfully. mf*

1st TREBLE.
2nd TREBLE.
BASS.

break - ers swell, Pick - ing out each pearl - ly shell; Look - ing so e - late and wise
ne - ver still, While our lit - tle pails we fill; Then, with fa - ces all a - glow,
i - vy fall Round our cot - tage gar - den wall; Soon we'll make it all com - plete,

D. t.

Ev - 'ry time we find a prize; While the wind, all fresh and free, Blows from off the
Crys - tal spar and co - rals show; Tell - ing how our grot - to soon Shall out - shine the
With a win - dow and a seat, Where we'll sit and sing like birds Mu - sic sweet to

shin - ing sea; While the wind, all fresh and free, Blows from off the shin - ing sea.
sun or moon; Tell - ing how our grot - to soon Shall out - shine the sun or moon.
joy - ous words; Where we'll sit and sing like birds Mu - sic sweet to joy - ous words.

Symph. for Harmonium.

Symph. for Harmonium.

Pupil Teacher's Examination Questions.

AUGUST, 1881.

FOURTH YEAR.

Pupil Teachers at end of Fourth Year, *if apprenticed on, or after, 1st May,* 1878; **and Pupil Teachers at end of Fifth Year,** *if apprenticed before that date.*

FIRST PAPER.

Three hours and a half allowed.

Arithmetic.

MALES.

1. On selling 4 dozen cucumbers for 13s. 0d. a profit was made equal to three-tenths of the money laid out in buying them. What ought the price charged per cucumber to the customer to have been, in order that 60 per cent. should be gained?

2. What is meant by 'discount'? What is the discount on £1,250, due 9 months hence, at 5½ per cent.?

3. In 3 years, at 4 per cent., what sum would £1,080 amount to at compound interest?

4. If by selling an article for 8s. 3d. I lose 17½ per cent., what should I have sold it for to gain 40 per cent.?

5. Explain the following quotation from the *Times* of November 29th:—'Consols opened this morning at a fresh decline of an eighth, and ultimately experienced a further fall. The first bargains were at 89⅝ to ¼, and the last at 89½ to ⅝. For the 7th of December the final quotation was 87⅞ to 88 ex. div.'

FEMALES

1. A house which cost £1,500 lets for £65 a year; the outgoings for insurance, etc., amount to 1¼ per cent. on its cost; what rate of interest does it pay?

2. An innkeeper uses a quart measure which is too small by ·375 of a pint; of how much will he defraud his customers in selling a butt of beer if he charges 2½d. for a pint?

3. The sales of a bookseller amount to £25,000; one-fourth of the sales are made at a profit of 25 per cent., seven-tenths at a profit of 16⅔ per cent., and the remainder at a loss of 25 per cent. Find the cost of the stock sold.

4. Three cowkeepers hire a pasture for £35 7s. 6d. for 26 weeks; during the time A puts 7 cows in it for 13 weeks, B 14 cows for 9 weeks, and C 3 cows for 22 weeks. How should they divide the rent?

Grammar.

1. *Be useful where* thou livest, that they may
Both want and wish thy pleasing presence still.
Kindness, good parts, great places, are the way
To compass this. *Find out men's wants* and will,
And meet them there. All worldly joys go less
To the one joy of doing kindnesses.

GEORGE HERBERT, 1633.

(*a*) Write out the meaning of the above in your own words.
(*b*) Parse the words in italics.
(*c*) Analyse the first two lines.
(*d*) How is the word *that* used in the first line? Give examples of the different ways in which the word *that* is employed.

2. Mention some of the classes of words in our language which are generally of Latin origin. Give examples.

Geography.

1. Draw a full map of Africa, *to the east of the 30th meridian of east longitude*—that is, to the east of Alexandria on the north, and of Port Natal on the south.

2. Describe fully the great mountain chains of America, and trace the courses of the principal rivers that rise in them.

SECOND PAPER.

One hour allowed for Females, two hours and a half allowed for Males.

History.

1. How were the Jews treated under Richard I.? Explain the feeling towards them.

2. By what authority were the Stuarts restored in 1660, and William and Mary placed on the throne in 1689?

3. Mention the chief military achievements of this country from 1704 to 1709, and explain the cause of the war of the Spanish succession.

Penmanship.

Write, in large hand, as a specimen of copy-setting, the word *Inexhaustible.*

Write, in small hand, as a specimen of copy-setting, *The Artisans' Dwellings Act,* 1875.

Composition.

Write a short essay on *The Navy.*

Euclid.

[The only abbreviations admitted for 'the square on AB' is 'sq. on AB,' and for 'the rectangle contained by AB and CB,' 'rect. AB, CD.']

1. If the sides of any hexagon be produced to meet, the angles formed by these lines are altogether equal to four right angles.

2. If a straight line be divided into two equal parts, and also into two unequal parts; the rectangle contained by the unequal parts, together with the square on the line between the points of section, is equal to the square on half the line.

3. If a straight line be bisected, and produced to any point, the square on the whole line thus produced, and the square on the part of it produced, are together double of the square on half the line bisected, and of the square on the line made up of the half and the part produced.

Algebra.

1. Reduce $\left(\frac{x^2-9x+20}{x^2-6x}\right)\left(\frac{x^2-13x+42}{x^2-5x}\right)$ to the simplest form.

2. Solve the equations:—

(1) $\begin{cases} ax = by \\ x+y = c \end{cases}$

(2) $12x^2 = x + 1740$.

3. Find two numbers in the proportion of 8 : 5, the product of which is 360.

Mensuration.

1. The paving of a semi-circular alcove with marble at 2s. 6d. a foot came to £10; what was the length of the semi-circular arc?

2. Find the area of a regular hexagon whose side is 15 feet.

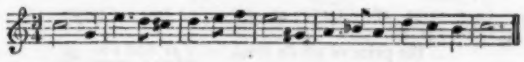
Music.

A quarter of an hour allowed for this paper.

1. Write the upper tetrachord of E (*Mi*) minor in every form with which you are acquainted. Mark the places of the semitones and augmented intervals.

2. Write under each of the following pairs of notes the name and quality (major, perfect, diminished, or other) of the interval it forms.

3. Transpose the following into B flat (*Se*).



ANSWERS.—FOURTH YEAR.

Arithmetic.

MALES.

1. ⅗ of buying price = 13s.

∴ the buying price $= \frac{13 \times 10}{13} = 10s.$

To gain 60 p. c. the 48 cucumbers must be sold for $10s. \times \frac{160}{100}$, or 16s., *i.e.*, $\frac{192d.}{48}$ or 4d. each.

2. There are two kinds of discount, namely, the *usual discount,* which is just interest on the amount of a bill or debt for the time it has still to run, and the *true discount,* which is the *interest* on the present value of the bill or debt. The latter is less than the former by the interest on the *true* discount.

To find the true discount on £1250, for 9 mos. at 5½ p. c.

(*a*) 12 mos. : 9 mos. :: £5½ : 4⅛ interest of £100 for 9 mos., or £4⅛ is the discount on £104⅛ for the given time.

∴ £104⅛ : £4⅛ :: £1250 : discount required.

$£1250 \times \frac{33}{825} = £49\ 10s.\ 4\frac{8}{11}d.$ Ans.

3. 4 p. c. gives $\frac{1}{25}$ of principal to be added yearly.

£1080
43·2
1123·2 = prin. for 2nd year.
44·928
1168·128 = prin. for 3d year.
46·72512
1214·85312 = amt. for 3 yrs.
20
17·06240s.
12
0·7488d.

∴ the amt. for 3 yrs. = £1214 17s. 0·7488d. Ans.

4. $82\frac{1}{2} : 140 :: 8\frac{1}{4}$s. : required price.
$\frac{33}{4}$s. × $\frac{280}{165}$ = $\frac{77}{4}$s. = 14s. Ans.

5. The quotation from *The Times* may be explained as follows:—When the Stock Exchange opened on the morning of the 29th November, the price of £100 in the Consolidated Funds was lower than the previous day by 2s. 6d. The £100 sold at first for £89 7s. 6d. and £89 10s.; at the close the price varied from £89 5s. to £89 7s. 6d. on the same day. The price of stock, the transfer of which was deferred till the 7th December, ranged from £87 17s. 6d. to £88; but the next half-yearly dividend, instead of being paid to the holders of this stock, was to be drawn by the sellers, *ex div.* meaning *excluding dividend.*

FEMALES.

1. The cost of insurance, etc., amounts to £1500 × $\frac{1\frac{1}{4}}{100}$, or

£$\frac{15 \times 5}{4}$ = £18 15s.

∴ the interest on £1500 = £65 − £18 15s., or £46 5s.

£100 = $\frac{£46\ 5s.}{15}$

i.e., £3 1s. 8d.

2. 1 butt = 108 galls. = 432 qts.
432 qts. at 5d. = 2160d.
Now ·375 of a pint = $\frac{3}{8}$ of a quart;
that is 13 parts are sold for 2160d.

∴ 3 ,, ,, ,, $\frac{2160 \times 3}{13}$

,, ,, ,, $\frac{6480}{13}$

i.e., 498$\frac{6}{13}$d., or 41s. 6$\frac{6}{13}$d.

Note.—He has 3 parts of the quantity or value to himself, *i.e.*, £2 1s. 6$\frac{6}{13}$d.

3. Cost price of $\frac{1}{4}$ of £25,000, at 25 p. c. profit = £6,250 × $\frac{125}{100}$ = £5,000.
Cost price of $\frac{7}{10}$ of £25,000 at 16$\frac{2}{3}$ p. c. profit = £17,500 × $\frac{100}{116\frac{2}{3}}$ = £15,000.
Cost price of £1,250 at 25 p. c. loss = £1,250 × $\frac{100}{125}$ = £1,666 13s. 4d.
∴ the price of whole stock = £21,666 13s. 4d.

4. 7 cows for 13 wks. = 91 for 1 wk.
14 ,, 9 ,, = 126 ,,
3 ,, 22 ,, = 66 ,,
283 ,,

	£	s.	d.	
$\frac{91}{283}$ of £$\frac{283}{4}$	= 11	7	6	A's
$\frac{126}{283}$,,	= 15	15	0	B's
$\frac{66}{283}$,,	= 8	5	0	C's

Grammar.

1. (*a*) Act a neighbour's part towards those among whom you live, so that they may both desire and feel the need of your continued stay amongst them. In order to bring this about you must act kindly, use your talents to the best advantage, and obtain an influential position. Meet men upon the common ground of human needs and human wishes, and endeavour to help them by acting up to the only happiness-giving maxim, 'It is more blessed to give than to receive.'

(*b*) *Be*—incomplete verb, *am*, *was*, *been*, imperative mood, pres. indef. tense, 2nd pers sing. agr. with subj. (*thou*).
useful—a predicative adj. qual. (*thou*).
where—rel. adv. modifying *livest.*
both—conj. corresponding with *and.*
want—trans. verb, weak conj. infin., pres. indef. gov. by *may.*
and—co-ordinating conj. connecting *want* and *wish.*
wish—trans. verb, weak conj. infin., pres. indef. gov. by *may.*
find out—compound trans. verb, weak conj. imperative, pres. indef. 2nd pers. sing. agr. with (*thou*).
men's—com. noun, plur., masc., possessive, attributive to *wants.*
wants—abstr. noun, neut., plur. obj. gov. by *find out.*

(*c*)

Sentence.	Subject.	Predicate.	Completion.	Extensions.
(a) Be useful. (Principal)	(thou)	be (*incomplete*)	useful	
(b) Where thou livest. [Adverbial to (a).]	thou	livest		where [and *connective*] (place)
(c) That they may want thy pleasing presence still. [Adverbial to (a).]	(that) they	may want	thy pleasing presence. (object)	still (time)
(d) (*That they may*) wish (*thy pleasing presence still*). [same as (c).]	(*that*) (they)	(*may*) wish	(*thy p'easing presence.*) (object)	(*still*) (*time*)

(*d*) The word *that* in the first line is used as a *subordinating conjunction* of *purpose.* This word is also a *relative pronoun* when it means either *who* or *which*, as, 'The man *that* spoke,' 'The book *that* is read'; a *demonstrative pronoun* when it stands for some thing or fact, as, 'I told him *that*,' and as a *demonstrative adjective* when it poin's out some expressed noun, as, 'I have heard *that* story.'

2. The classes of words in our language generally of Latin origin are *Ecclesiastical terms*, introduced by Augustine, and *miscellaneous words* brought to England through commercial relations with southern Europe, terms connected with *Feudalism*, *war*, *the chase*, *Legal terms*, *titles*, *terms connected with the Church*, and *domestic life*, introduced by the Normans, and latterly by the study of science and philosophy, and the almost exclusive study of classical literature in our grammar schools and universities, a great addition has been made to *scientific* and other terms.

Geography.

2. *South America.*—The Andes, perhaps the most remarkable chain in the globe for length, height and internal structure, extend from Cape Horn through the whole length of South America, by several parallel ranges of peaks supported upon a continuous plateau, to the Isthmus of Panama. For convenience the system may be divided into the *Chilian Andes*, *Bol vian Andes*, the *Andes of Quito*, and the *Northern Chains.* The heights in the Bolivian Andes form by far the most imposing group in the whole chain, but the highest point, *Aconcagua*, 23,910 feet, is situated in the Chilian Andes. The peaks visible from the celebrated valley of Quito are said to form an assemblage scarcely surpassed by the Bolivian Andes.

The principal river having its rise in the Andes is the *Amazon*, which is fed by tributary streams from the Northern Chains, the Andes of Quito, and the Bolivian Andes. The main stream flows east, crossing the whole breadth of the continent, and falls into the Atlantic Ocean. The *Magdalena*, with its parallel stream the *Cauca*, flows north to the Caribbean Sea, and the *Orinoco*, formed partly by tributary streams from the Andes, flows easterly into the Atlantic.

The *Brazilian system* of mountains give rise to the *Parana* and *Paraguay*, flowing south to the estuary of the *Rio-de-la-Plata*, the *San Francisco* flowing north and east to the Atlantic, the *Tocantin* and several other branches of the Amazon flowing north.

The principal mountain system of North America is the *Rocky Mountains*, which are connected by the *Plateau of Mexico*, and the *Chain of Central America* with the Andes. The Rocky Mountains give rise on the west slope to the *Rio Colorado*, flowing south to the Gulf of California, and the *Columbia River*, flowing south and west. On the eastern slope rise the *Athabasca*, continued by the *Mackenzie River* to the Northern Ocean; the *Missouri* and the other numerous branches on the right bank of the Mississippi, and the *Rio Grande* flowing south-east to the Gulf of Mexico. The *Ohio* and its tributaries on the left bank of the Mississipi rise in the *Alleghany Mountains*, which, with the *Green Mountains*, form a range parallel with the Atlantic. Close along the *Pacific Ocean* runs the almost continuous range of the *Sierra Nevada*, *Cascade Mountains*, and the *Sea Alps*.

History.

1. On the day of Richard's coronation the hatred of the mob led to a fearful massacre of the Jews in London, and in York Castle a still more hideous tragedy was enacted in the self-slaughter of five hundred Jews, after first killing their own wives and children. The Jews were hateful to the people, both because they were not Christians, and because they were usurers. They alone could lend money on interest, for the Scriptures were thought to forbid that practice to Christians, and thereby they made enormous profits. They were accused of horrible crimes, and were often subjected to great cruelties by the fierce and ignorant people among whom they lived.

2. The Stuarts were restored in 1660 by the authority of the *Convention Parliament*, which was called by the remnant of the Long Parliament "purged" out by Colonel Pride. William and Mary were placed on the throne, 1689, by the authority of the *Convention of the Estates of the Realm*, summoned by the Prince of Orange. The assembly, though equivalent to a parliament, could not be so called on account of its not being assembled by a king.

3. The chief military achievements from 1704 to 1709 were:—*Battle of Blenheim*, 1704; *Capture of Gibraltar*, 1704; *Capture of Barcelona*, 1705; *Battle of Ramillies*, 1706; *Battle of Almanza*, 1707; *Battle of Oudenarde*, 1708; *Battle of Malplaquet*, 1709; *Capture of Mons*, 1709

Louis XIV., having attempted to place his grandson, afterwards Philip V., on the Spanish throne, caused England, Holland, and the Emperor to unite in a "Grand Alliance," which was joined in by many European powers. War with France was declared, the Allies supporting the claim of the Archduke Charles of Austria to the Spanish Crown. This war is known by the name of the War of the Spanish Succession.

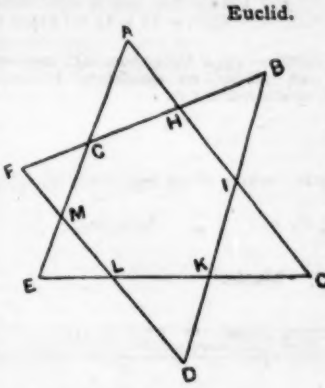
Composition.

The Navy.

To no nation in the world is the possession of a strong navy of such moment as to our own country of Great Britain. Our insular position, proximity to France (our ancient rival), our Colonial possessions, and immense wealth make us a favourite object of jealousy. The navy is our first and best line of defence, and it has been said that if we are unable to cope with the combined fleets of two or three hostile powers we shall be dependent on sufferance for our existence, and shall cease to be a first-rate power.

From early times this fact has been acknowledged, for Alfred and his successors maintained a fleet for the defence of the coasts. William I. established the Cinque Ports as the origin of a maritime force, and the great land-owners used to furnish the means of equipment and maintenance of warships. Though under the Plantagenets many naval victories were gained, yet it was not till the reign of Henry VII. that the Royal Navy had permanent existence. The *Great Harry* was followed by the building of the *Henry Grace-à-Dieu*. The attention of Elizabeth was early directed to the importance of a powerful naval force, and the patriotism of the people enabled her to equip a respectable fleet to meet the Armada. Charles I. understood the value of a navy better than his father, and therefore employed an eminent architect in constructing ships, so that Cromwell, on his accession to power, found the nucleus of a maritime force, which he raised to a grander height than it ever had reached before, and with Penn, Blake, and Lawson for admirals, it forced from the Dutch the empire of the seas. Under James II., who commanded the fleet before he became king, the royal navy was improved, both in men and material. Since that time the navy has gained victories on every sea, commanded by admirals like Howe, Jervis, Nelson, and Codrington.

Euclid.



1. Let GHIKLM be any hexagon, and let the sides of it be produced to meet in A, B, C, D, E, and F. Then ACE, FBD form two triangles cutting each other. Now the interior angles of every triangle are together equal to two right angles, therefore the angles at A, C, E, F, B, D, are together equal to four right angles because they are the interior angles of ACE, FBD, respectively.—Q.E.D.

2. Prop. v., bk. 2.
3. Prop. x., bk. 2.

Algebra.

1. $\left(\frac{x^2-9x+20}{x(x-6)}\right)\left(\frac{x^2-13x+42}{x(x-5)}\right)=$

$$\frac{(x-5x)(x-4x)(x-7)(x-6)}{x^2(x-6)(x-5)}=$$

$$\frac{(x-7)(x-4)}{x^2}=$$

$$\frac{x^2-11x+28}{x^2}=$$

$$1-\frac{11}{x}+\frac{28}{x^2}$$

2. (1) $ax = by$ or $x=\frac{by}{a}$

(2) $x+y=c$ or $x=c-y$

$$\therefore c-y=\frac{by}{a}$$

$$ac-ay=by$$

$$ac=by+ay$$

$$y=\frac{ac}{a+b}$$

By substituting $\frac{ac}{a+b}$ for y in (2)

$$x+\frac{ac}{a+b}=c$$

$$x=c-\frac{ac}{a+b}$$

$$x=\frac{ac+bc-ac}{a+b}=\frac{lc}{a+b}$$

2. $12x^2-x=1740$

$$x^2-\tfrac{1}{12}x=145$$

$$x^2-\tfrac{1}{12}x+\tfrac{1}{576}=\frac{145\times576+1}{576}=\frac{83521}{576}$$

$$x-\tfrac{1}{24}=\pm\tfrac{289}{24}$$

$$x=\tfrac{1}{24}\pm\tfrac{289}{24}=\tfrac{290}{24} \text{ or } -\tfrac{288}{24}$$

$$\therefore x=12\tfrac{1}{12} \text{ or } -12$$

3. If x = the greater, then the less $=\frac{5x}{8}$

$$\therefore \tfrac{3}{8}x^2=360$$

$$5x^2=2880$$

$$x^2=576$$

$$x=24. \text{ Ans.}$$

$$\therefore y=24\times\tfrac{5}{8}$$

$$=15. \text{ Ans.}$$

Mensuration.

1 $2\frac{1}{2}$s. = price of 1 square ft.

$\therefore$ £10 = " 80 square ft. = area of alcove.

Area of whole circle = 160 square ft.

$$\therefore \text{diameter} = 2\sqrt{\frac{160}{3\frac{1}{7}}}=2\sqrt{50\cdot90}=14\cdot27 \text{ ft.}$$

and so length of semi-circular arc = 7·135 ft. × $3\frac{1}{7}$ = 22·42 ft. Ans.

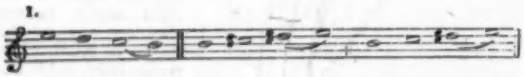
2. Since a regular hexagon can be cut into 6 equilateral triangles, then the area of given hexagon = 15 × 15 × ·433 × 6

15
15
225
·433
675
675
900
97·425 sq. ft. = area of one equilateral triangle.
6
584·55 sq. ft. = ,, hexagon

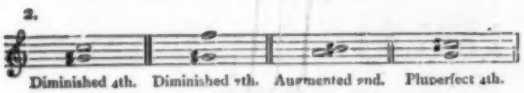
NOTE:—*·433 is the approximate area in sq. ft. of an equilateral triangle whose side is 1 ft.*

Music.

1.



2.



Diminished 4th. Diminished 7th. Augmented 2nd. Pluperfect 4th.

3.

SEPTEMBER, 1881.

CANDIDATES.

Three hours and a-half allowed.

Arithmetic.

MALES.

1. A bankrupt's debts are £3560, and his property is worth £1349 16s. 8d. How much will his creditors lose in each pound?
2. If wheat be 6s. a bushel, what will 7 loads, 4 quarters, 3 bushels cost?
3. Find the value, in current coin, of 3 cwt. 2 qrs. 11 lbs., knowing that 27 cwt. 19 lbs. cost £37 16s. 4½d.
4. Find the value of a crop on 24 acres 3 roods and 4 poles, at £9 8s. 4d an acre.
5. If the rate of wages depends on the price of wheat, and 18 men working for 4 weeks receive £43 4s. 0d., when wheat is 64s. a quarter; find the price of wheat per quarter when 16 men, working for 5 weeks, obtain £67 10s. 0d.

FEMALES.

1. Make out the following bill:—
   60½ lbs. of tea at 2½d. per oz.
   78 cwt. 97 lbs. sugar at 9s. 4d. per qr.
   24¾ cwt. cocoa at 1s. 4d. per lb.
   18 cwt. 2 qrs. 7 lbs. rice at 2½ per lb.
   376¾ lbs. coffee at 1s. 8d. per lb.
2. Find the cost of 6894½ articles at £162 8s. 2½d. each.
3. Find, by Practice, the cost of 870 miles 3 fur. 35 perches at £27 15s. per league.
4. Find, by Practice, the value of 258½ score of sheep at £2 13s. 8d. each sheep.

Grammar.

1. Parse all the nouns, verbs, and adjectives in the following:—

   'All heads must come
   To the cold tomb,
   Only the actions of the just
   Smell sweet and blossom in the dust.'

   JAMES SHIRLY.

2. What are the different moods of the verb? Give two examples of verbs in the imperative, and two of verbs in the subjunctive moods.
3. Explain what is meant by active and passive verbs.

Geography.

1. What are the chief ranges of hills in the South of Scotland? Describe fully the position of each, and the courses of the rivers that rise in them.
2. Say what you know about the physical features, productions, and industrial occupations of Norfolk, Devonshire, Glamorganshire, and Kerry.
3. Describe minutely the course of a vessel sailing along the coast from Dover to Southampton, and then crossing over to visit each of the Channel Islands.

Composition.

Write from dictation the passage given out by the Inspector.

Penmanship.

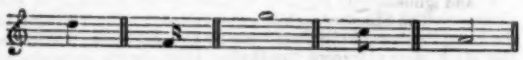
Write, in large hand, as a specimen of copy-setting, the word *Apprehensive.*

Write, in small hand, as a specimen of copy-setting, *The Metropolitan Street Improvements Act.*

Music.

A quarter of an hour allowed for this paper.

1. Write over each of the following notes its pitch name (C, D, *Do. Re*, or other), and under each its duration name (crotchet, quaver, or other).



2. Follow each of these notes by its corresponding rest.

3. How many tones and semitones are found in a major scale and what places therein do the latter occupy?

CANDIDATES.—ANSWERS.

Arithmetic.

MALES.

1. £3560 − £1349 16s. 8d. = £2210 3s. 4d. of loss
   ∴ £3560 : £1 :: £2210 3s. 4d. : loss per £1

```
                    20
3560)44203(12s. 5d.
     42720
      1483
        12
     17800
     17800
```

2. 7 loads 4 qrs. 3 bush.
   5
   39 qrs.
   8
   315 bushels at 6s. = 1890s. = £94 10s. Ans.

3. 27 cwts. 19 lbs. = 3043 lbs.
   3 cwts. 67 lbs. = 403 lbs.
   £37 16s. 4½d. = 36305 farths.
   ∴ 3043 lbs. : 403 lbs. :: 36305 farths. : price in farths.

```
                  403
                14630915
              1452200
            108915
          3043)14630915(4808 farths.
               12172
               24589
               24344
                24515
                24344
                  171
                  403
```

∴ Ans. = £5 0s. $2\frac{171}{3043}$d.

4. Value of 1 ac. ... ... = £ 9 s. 8 d. 4 6

50 10 0 4

Value of 24 ac. ... ... = 226 0 0
" 2 ro. = ½ value of 1 ac. = 4 14 2
" 1 ro. = ½ " 2 ro. = 2 7 1
" 4 po. = 1/10 " 1 ro. = 0 4 8½
" 24 ac. 3 ro. 24 po. = 233 5 11½ Ans.

5. 16 men : 18 men
5 wks. : 4 wks. } :: 64s. : x.
864s. : 1350s.
64s. × 18/16 × 4/5 × 1350/864 = 90s. Ans.

FEMALES.

1. 60¾ lbs. at 0s. 2½d. per lb. ... ... = £ 10 s. 1 d. 8
78 cwts. 97 lbs. at 9s. 4d. per qr. ... = 147 4 4
24¾ cwts. at 1s. 4d. per lb. .. ... = 184 16 0
18 cwts. 2 qrs. 7 lbs. at 0s. 2½d. per lb. = 21 13 1½
376¾ lbs. at 1s. 8d. per lb. ... ... = 31 7 11
£395 3 0½

2. Value at £1 ... ... = £ 6894 s. 10 d. 0 2
13789 0 0 9
124101 0 0 9
" £162 ... ... = 1116909 0 0
" 6s. 8d. = ⅓ value at £1 ... = 2298 3 4
" 1s. 4d. = 1/5 " 6s. 8d. = 459 12 8
" 2d. = 1/12 " 1s. 4d. = 57 9 1
" ½d. = 1/4 " 2d. = 14 7 3½
" £162 8s. 2½d. ... ... = £1119738 12 4½

3. £27 15s. per league = £9 5s. per mile.

Value of 1 ml. ... ... = £ 9 s. 5 d. 0 870
" 870 mls. ... ... = 8047 10 0
" 2 fur. = ¼ value of 1 ml. = 2 6 3
" 1 " = 1/7 " 2 fur. = 1 3 1⅛
" 20 per. = ⅛ " 1 " = 0 11 6¾
" 10 " = ¼ " 20 per. = 0 5 9⅜
" 5 " = ½ " 10 " = 0 2 10 1/16
£8051 19 7 15/16 Ans.

4. 258½ score = 5170 sheep.

Value at £1 ... ... = £ 5170 s. 0 d. 0
" £2 ... ... = 10340 0 0
" 10s. = ½ at £1 ... = 2585 0 0
" 3s. 4d. = 1/3 at 10s. . = 861 13 4
" 4d. = 1/12 at 3s. 4d. = 86 3 4
" £2 13s. 8d. ... = £13872 16 8. Ans.

Grammar.

1. *All*—indef. num. adj. qual. *heads*.
heads—com. noun, neut., plur., nom. to *must come*.
must—aux. verb, pres. indef. indic. forming with infinitive.
come—pres. indef. potential of *come, came, come*, and agrees with its subj. *heads*.
cold—adj. qual. *tomb*.
tomb—com. noun, neut. sing. obj. gov. by *to*.
actions—abstr. noun, neut. plur. nom. to *smell*.
just—adj. qual. (*persons*), used as a noun, com. plur. obj. gov. by *of*.
smell—intrans. reg. verb. indic. pres. indef. 3rd pers. plur. agr. with subj. *actions*.
sweet—adj. used adverbially.
blossom—intrans. reg. verb. indic. pres. indef. 3rd pers. plur. agr. with subj. *actions*.
dust—com. noun, neut. sing. obj. by *in*.

2. The different moods of the verb are:—*Indicative, Potential, Subjunctive, Imperative*, and *Infinitive*. *Do* this, *write* these words; I fear lest he *come*, I care not though he *die*, *Do*, *write* are examples of the *Imperative*, and *come, die* of the *Subjunctive mood*.

3. Verbs are said to be *Active* when the subject *acts*, and *Passive* when the subject is *acted* upon; as, The boy *strikes* (active) the table. The table *is struck* (passive). The passive is merely used as a change of form, and only verbs which take an object can properly be changed into the passive, the *object* in the *active voice* becoming the *subject* in the *passive*.

Geography.

1. The chief hills in the south of Scotland are the *Cheviots*, forming a natural boundary between England and Scotland, giving rise to several affluents of the Tweed flowing N., the *Moffat*, and *Lowther*, and *Lead Hills*, in the N. of Dumfriesshire, from which flow the *Liddell, Esk*, and *Annan*, S. to the Solway, the *Clyde* N.W. through Lanark, and the *Tweed* N. and E. through Peebles, Selkirk, Roxburgh, and between Berwick and Northumberland; the Ayrshire Hills take a crescent-like form, enclosing the county, and give rise to the *Nith* flowing S. to the Solway, and the *Ayr* and *Irvine* flowing W., the *Doon* flowing N.W., the *Stinchar* and the *Girvan* flowing S.W. all into the Firth of Clyde. The *Lammermuirs* and the *Moorfoot Hills*, the former between Haddington and Berwick, and the latter mostly in Mid-Lothian, give rise to several small branches of the Tweed flowing south, and the *Tyne*, in Haddington, flowing easterly.

2. *Norfolk.*—The greater part of the county is occupied by the East Anglian heights, which overlook a strip of the Fens included within the limits of Norfolk, and through which flows the Great Ouse. The chief of the other rivers are the *Bure*, the *Yare*, and the *Waveney*, having the same opening into the sea at Yarmouth. The industries are agriculture, shipping-trade, and fisheries, with some small manufactures of silk crape and baize.

Devonshire stretches across from the Bristol to the English Channel, and naturally divides itself into these three parts—(1) *Exmoor* in the N., (2) *Dartmoor* in the S., and (3) a broad plain of pasture land between them. The first two are wild tracts, while the last is beautiful and fertile. The county is mainly *agricultural* and *mining*, but some shipbuilding is carried on at the various ports. Devon is noted for *cider*, and its *butter* is the best in the world. The rivers are the *Exe, Tawe, Tamar, Dart, Axe, Torridge*, and *Teign*.

Glamorganshire occupies the most southern part of Wales. It is wild and mountainous in the N., but level and fertile towards the S. The "Vale of Glamorgan" has been styled the "Garden of Wales." The principal rivers are the *Taff*, the *Tawe, Avon*, and *Neath*. It is eminently a mining and manufacturing county. *Coal* and *iron* are abundant, and by means of these minerals it has become a great centre of iron-smelting and manufacturing trades.

Kerry is a county in the S.W. of Ireland. Its surface is chiefly formed of mountain ranges, in which are Macgillicuddy's Reeks, with Carntual (3404 ft.), the highest summit in Ireland. Its rivers are unimportant, but its lakes comprise those of Killarney, famed for picturesque scenery. The coast is deeply indented with the Bays of *Tralee, Dingle*, and *Kenmare*. Off the coast is *Valentia*, a terminus of the Atlantic telegraph cables. The county is rich in minerals; but dairy-farming is the leading industry.

3. Leaving the thriving town of *Dover*, which has a great passenger traffic with *Calais*, we pass *Folkestone*, the neat bathing-town of *Hastings*, Brighton, a beautiful town, the favourite resort of George IV., and lying to the west of *Beachy Head* and *Newhaven*, which trades with *Dieppe*. Continuing westerly along the coast of Sussex, we round *Selsea Bill* and come to the safe anchorage of *Spithead*, noting the strongly fortified naval station of *Portsmouth*. After a run up to visit the packet station of *Southampton*, we turn south, passing through the *Solent*, N.W. of the Isle of Wight, and voyage still southwards to the Channel Islands, which, including *Jersey, Guernsey, Alderney*, and *Sark*, are all that remain of our Norman possessions. Alderney is noted for its cows. *St. Helier* is the capital of Jersey, and St. Peter's Port of Guernsey. These islands are officially included in the county of Hampshire.

Music.

2.

3. Five tones and two semitones, the latter being found between the third and fourth, and seventh and eighth notes of the scale.

FIRST YEAR.

Pupil Teachers at end of First Year.

Three hours and a-half allowed.

Arithmetic.

MALES.

1. Find the cost of $6\frac{1}{4}\frac{3}{5}$ tons of hay at the rate of $£3\frac{1}{7}\frac{1}{7}$ for a ton and a quarter.
2. What sum of money is the same fraction of £7 that $\frac{3}{5}$ of 5s. is of 17s. 6d.?
3. Find the quotient to 5 places of decimals, of 17·171717 divided by the product of 19·85 multiplied by 17·3.
4. What decimal fraction is equal in value to $\frac{25\frac{3}{4}}{3535\frac{1}{2}}$?
5. Out of $£4\frac{3}{4}$ one third is paid to A., and one seventh to B. After this, $\frac{4}{11}$ of the remainder is paid to A., and the rest to B. Find the sums received respectively by A. and B.

FEMALES.

1. A bankrupt owes £7065, but he can only pay 7s. 6d. in the pound; what amount of money will he leave unpaid?
2. If goods are carried 809 miles for £6 14s., how far could th y be carried for £91 19s. 9d. at the same rate?
3. If 32 men mow 96 acres of grass in 8 days, how many men must be employed to mow a square mile in 20 days?
4. If 12 yds. of silk, 18 inches wide cost £3 12s, what will be the cost of 13½ yds. of the same quality silk 21 inches wide?

Grammar.

1. Parse the pronouns and prepositions in the following:—

> 'With joy unfeign'd brothers and sisters meet,
> An' each for other's welfare kindly spiers:
> Each tells the uncos that he sees or hears;
> The parents, partial, eye their hopeful years.'
>
> BURNS.

2. Name the interrogative pronouns, and state which of them are used both substantively and adjectively, and which only substantively; give examples.
3. Of prepositions some are simple; some compound, or derivative. Give examples of each; and, if you can, show from what words the compound prepositions are made up.

Geography.

Answer either Q. 2, *or* Q. 3; not both.

1. Draw a map of Scotland to the South of the Firths of Forth and Clyde, showing the chief ranges of hills, the courses of the principal rivers, the coast line, and chief towns.
2. Name the chief rivers which rise in the Alps; and describe their courses.
3. Name the chief seaports on the Mediterranean, and say what you know about each of them.

History.

1. Write down the names and dates of our kings from Canute to William I.
2. How many kings named Henry have sat on the throne? Give their dates and mention their immediate successors.
3. Make a list of our sovereigns from 1702 to the present time, with the dates of their accession.

Penmanship.

Write, in large hand, as a specimen of copy-setting, the word *Apprehensive.*

Write, in small hand, as a specimen of copy-setting, *The Metropolitan Street Improvements Act.*

Composition.

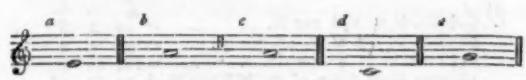
Write from memory the substance of the passage read to you by the Inspector.

Music.

A quarter of an hour allowed for this paper.

1. Write in *a* the scale of G (*Sol*), and in *b* the scale of F (*Fa*), placing a sharp or a flat before each note requiring one. Mark the places of the semitones.

2. Place its second over *b*, its third over *b*, its fourth over *c*, its fifth over *d*, and its octave over *e*.



3. How many semiquavers are equal (in length) to one minim?
How many quavers are equal (in length) to one dotted minim?
How many crotchets are equal (in length) to one semibreve?

ANSWERS.—FIRST YEAR.

Arithmetic.

MALES.

1 $1\frac{1}{4}$ tons = $\frac{5}{4}$ tons; $6\frac{1}{4}\frac{3}{5}$ tons = $\frac{313}{50}$ tons; $£3\frac{1}{7}\frac{1}{7} = £\frac{113}{35}$.
$\therefore \frac{5}{4} : \frac{313}{50} :: £\frac{113}{35} : x$.
$£\frac{113}{35} \times \frac{313}{50} \times \frac{4}{5} = £\frac{8\,9\,5\,2}{3\,5\,0\,0} = \frac{1}{4}$d. $\times 5957 =$
$17\frac{8}{4}\frac{5}{2}\frac{1}{1}$d. $= 4467\frac{7}{8}$d. $= 372$s. $3\frac{7}{8}$d. $=$
£18 12s. $3\frac{7}{8}$d. Ans.

2. $\frac{\frac{3}{4}\text{ of }5\text{s.}}{17\frac{1}{2}\text{s.}} = \frac{15}{175} = \frac{3}{35}$. Now the question is, what sum is $\frac{3}{35}$ of £7?

$\frac{3}{35}$ of £7 = $£\frac{3\times 7}{28} = £\frac{3}{4}$ or 15s. Ans.

3.

19·85		
17·3		
5955		
13895		
19850		
343·405)	17·171717	(·05000+
	17 17025	
	146717	

4.

$$\frac{25\frac{3}{4}}{3535\frac{1}{2}} = \frac{\frac{103}{4}}{\frac{7}{24750}} = \frac{721}{99000} = \frac{·721}{99} = ·00728. \text{ Ans.}$$

5. $\frac{1}{3}+\frac{1}{7} = \frac{7+3}{21} = \frac{10}{21}$; $\frac{4}{11}$ of the rem. $\frac{11}{11} = \frac{4}{11}$; $\frac{11}{11} - \frac{4}{11} = \frac{7}{11}$.

		£	s.	d.	
$\therefore$ A gets	$\frac{1}{3}+\frac{4}{11}$ or $\frac{11}{21}$ of £4 7s. 6d.	= 2	5	10	A's.
B ,,	$\frac{1}{7}+\frac{7}{11}$ or $\frac{18}{21}$,,	= 2	1	8	B's. Ans

FEMALES.

1. Since only 7s. 6d. is paid, 12s. 6d. must be unpaid on every £; $\therefore$ 12½s. × 7065 = 88312s. 6d. = £4415 12s. 6d. Ans.

2. £6 14s. = 134s. = 1608d.
£91 19s. 9d. = 1839s. 9d. = 22077d.
$\therefore$ 1608d. : 22077d. :: 809 miles : x miles.

$$\frac{809 \text{ mls.} \times 22077}{1608} = \frac{809 \times 7359}{536} = \frac{5953431}{536} =$$
$$11107\tfrac{359}{536} \text{ mls. Ans.}$$

3. 96 ac. : 640 ac. } :: 32 men : x men.
20 days : 8 days }

$$\frac{32 \text{ men} \times 640 \times 8}{96 \times 20} = \frac{2\,5\,6}{1\,9\,2} = 8\tfrac{1}{3} \text{ men. Ans. (The } \tfrac{1}{3} \text{ may be}$$

explained as one who can do the third part of a man's work.)

4. $\left.\begin{matrix}48 \text{ qrs.} : 53 \text{ grs.} \\ 18 \text{ in.} : 21 \text{ in.}\end{matrix}\right\} :: £3\ 12s. : x.$

$$\frac{72s. \times 53 \times 21}{48 \times 18} = 82\tfrac{1}{4}s. = \underline{£4\ 12s.\ 9d.}\quad \text{Ans.}$$

Grammar.

1. *each*—distrib. adj., pron. com. sing., nom. to *spiers.*
other's—indef. adj., pron. com., sing. poss., qual. *welfare.*
each—*same as before* mas., nom. to *tells.*
that—simple rel. pron., neut. plur., standing for *uncos.*, obj. gov. by *sees* or *hears.*
he—3rd pers. pron., mas., sing., nom. to *sees* or *hears.*
their—pronom. poss. adj. (or poss. of *they*), qual. *years.*
with—prep. gov. obj. case *joy.*
for— ,, ,, ,, *welfare.*

2. The interrogative pronouns are *who, which, what, and whether. Which* and *what* are used both substantively and adjectively, as, *which* (adj.) dress do you prefer? I know not *which* (subs.) is *which. What* (subs.) is sweeter than honey? *What* (adj.) towns are in Devon? *Who* is used only substantively, as, *Who* are you? *Whether* is now rarely used as a pronoun, but it occurs in earlier English, as, Whether of them twain did the will of his father?

3. Simple prepositions are—*at, by, down, for, from, in, of.* Compound, or derivative prepositions are—*abaft* (à-be-æftan), *above* (á-be-úfan), *before* (bi-foran), *beside* (= by side), *between* (= by two), *across* (French croix).

Geography.

2. The chief rivers which rise in the Alps are the *Rhine*, the *Rhone*, and the *Po*.

The *Rhine* rises in Mt. St. Gothard, passes through L. Constance, divides Switzerland from Germany, flows through the German States till, passing into Holland, it separates into two branches, and falls by several mouths into the North Sea. It is the most picturesque river of Europe. The *Rhone* rises in Switzerland about five miles from the source of the Rhine, and enters L. Geneva, from which it issues to flow west to the city of Lyons in France. It then turns south and enters the Mediterranean by four months. It is the most rapid river in Europe. The *Po* issues from Mt. Viso in the Cottian Alps, and traversing the plains of Piedmont and Lombardy from west to east, flows by several mouths into the Adriatic.

3. Beginning at the Spanish coast, we find *Barcelona*, the second city of Spain, with important manufactures and exports of iron, cork, and fruits. *Marseilles*, the first port in France, has immense trade with Algiers. *Toulon* has been termed the 'Brest of the Mediterranean' and the 'Plymouth of France.' *Leghorn* is the chief port of Italy with a fine harbour; exports silks, straw hats, &c. *Brindisi*, on the south-east coast of Italy, is the nearest sea-port to Alexandria on the European system of railways. *Ancona* on the Adriatic and *Venice*, with its numerous canals and hundred islands, are great entrepôts for European goods. *Trieste* is the chief port in Austria. *Smyrna*, on the coast of Asia Minor, is the principal port in the Levant *Alexandria*, the chief port of Egypt, is one of the stations on the 'Overland Route.'

History.

			A.D.
1.	Canute	began to reign	1017
	Harold	,, ,,	1035
	Hardicanute	,, ,,	1040
	Edward (the Confessor)	,, ,,	1042
	Harold II.	,, ,,	1066
	William I. (the Conquerer)	,,	1066

2. Eight kings of the name of Henry have sat on the throne, namely:—

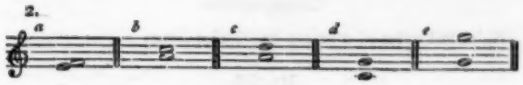
		A.D.			A.D.
Henry I.	began to reign	1100;	suc. by	Stephen	1135
Henry II.	,,	1154;	,,	Richard I.	1189
Henry III.	,,	1216;	,,	Edward I.	1272
Henry IV.	,,	1399;	,,	Henry V.	1413
Henry V.	,,	1413;	,,	Henry VI.	1422
Henry VI.	,,	1422;	,,	Edward IV.	1461
Henry VII.	,,	1485;	,,	Henry VIII.	1509
Henry VIII.	,,	1509;	,,	Edward VI.	1547

			A.D.
3.	Anne	began to reign	1702
	George I.	,, ,,	1714
	George II.	,, ,,	1727
	George III.	,, ,,	1760
	George IV.	,, ,,	1820
	William IV.	,, ,,	1830
	Victoria	,, ,	1837

Music.

1.

2.



3. Eight.
Six.
Four.

SECOND YEAR.

Pupil Teachers at end of Second Year.

Three hours and a-half allowed.

Arithmetic.

MALES.

1. Find simple interest on £976 10s. 0d for a year and a quarter at 3½ per cent. per annum.

2. A barrel of beer (36 gals.) lost by leakage 8 per cent. How many pints of beer were left in the cask?

3. A sum of money was lent on the 10th of September, and by the 2nd of November the interest, at 4½ per cent. per annum, amounted to £1 0s. 8¾d. What was the sum lent?

4. If, in 2 years and 63 days, the simple interest on £325 is £24 14s. 3½d., what is the rate per cent. per annum?

5. If an Exchequer bill for £1000 bears interest at the rate of 2s. a day, what is the interest per cent. per annum on the bill?

FEMALES.

1. Reduce to the least common denominator $\frac{1}{2}$, $\frac{3}{10}$, $\frac{5}{12}$, $\frac{11}{33}$, $\frac{5}{6}$, $\frac{11}{11}$.

2. Multiply the sum of $3\frac{3}{8}$, $4\frac{1}{2}$, and $4\frac{1}{4}$, by the difference of $7\frac{3}{4}$ and $5\frac{1}{8}$; and divide the product by the sum of $9\frac{1}{4}$ and $4\frac{1}{2}$.

3. If a yard of lace cost £1 $\frac{3}{4}$, what will 16$\frac{1}{2}$ yards cost?

4. If $\frac{3}{8}$ of a ship be worth £3740, what is the value of the whole?

Grammar.

1. 'The merry part of *mankind* are very *amiable*, whilst they diffuse a cheerfulness *through* conversation at proper seasons; but *on the contrary*, they are a great *grievance* to society when they infect every discourse with insipid mirth, and turn into ridicule *such* subjects *as* are not *suited* to it.'

ADDISON.

(*a.*) Point out the conjunctions in the above, and say to which class of conjunctions each belongs.

(*b.*) Parse the words in italics.

(*c.*) Analyse the adverbial and adjectival sentences in the above.

2. Show, by examples, that the words *since, but,* and *except* may be sometimes conjunctions and sometimes prepositions.

Geography.

Answer *either* Q. 1, *or* Q. 3; *not both.*

1. Name the chief rivers which rise in the Alps, and describe their courses.

2. Draw a full map of our possessions in South Africa and the countries bordering on them.

3. Give notes of a lesson on 'the physical features, climate, productions, inhabitants, and history of Jamaica.'

One hour allowed for Females.
Two hours and a-half allowed for Males.

History.

1. How came a Roman Emperor to be proclaimed in York A.D. 306? Who was he, and how connected with Britain?

2. Who was Canute? Into what earldoms did he divide this kingdom?

3. In the 13th century what part was taken by Cardinal Langton in securing English freedom?

Penmanship.

Write, in large hand, as a specimen of copy setting, the word *Apprehensive.*

Write, in small hand, as a specimen of copy-setting, *The Metropolitan Street Improvements Act.*

Composition.

Write full notes of a lesson on *Timber Trees.*

Euclid.

[All generally understood abbreviations for *words* may be used.]

1. Define *straight line, plane superficies, obtuse angle, circle, regular polygon, parallel straight lines, axiom.*

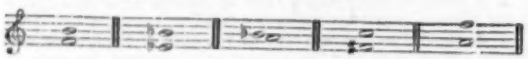
2. If two angles of a triangle be equal to each other, the sides also which subtend, or are opposite to, the equal angles, shall be equal to one another.

3. If two triangles have two sides of the one equal to two sides of the other, each to each, but the angle contained by the two sides of one of them greater than the angle contained by the two sides equal to them, of the other; the base of that which has the greater angle shall be greater than the base of the other.

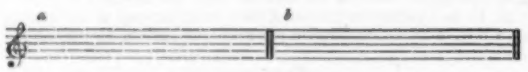
Music.

A quarter of an hour allowed for this paper.

1. Write, under each of the following, the name and quality (major, perfect, or other) of the interval it forms.



2. Write in *a* two measures of common time, and in *b* two measures of triple time.



3. Write in *a* the signature of F (*Fa*), in *b* that of E♭ (*Me*), in *c* that of G (*Sol*), and in *d* that of A (*La*).

ANSWERS.—SECOND YEAR.

Arithmetic.

MALES.

1. $£976\frac{1}{2} \times 1\frac{1}{2} \times \frac{3\frac{1}{2}}{100} = £\frac{1953 \times 5 \times 7}{2 \times 4 \times 200} = £\frac{19553 \times 35}{16} =$
$£\frac{68355}{16} = £\frac{683 \text{ lls. } 0\text{d.}}{4 \times 4} = \underline{£42 \text{ 14s. } 5\frac{1}{4}\text{d.}}$ Ans.

2. 36 galls. $= 36 \times 8$ or 288 pts.; and since by losing 8 per cent., 92 pts. are left out of every 100,
i.e., $\frac{92}{100}$ $\therefore \frac{288 \times 92}{100} = \underline{264\frac{4}{5}}$ pts. Ans.

3. (*a*) The number of days from 10th Sept. till 2nd Nov. $= 20 + 31 + 2 = 53$
(*b*) £1 0s. $8\frac{2}{3}\text{d.} = 248\frac{2}{3}\text{d.} = \frac{745}{3}\text{d.}$
(*c*) £$4\frac{2}{3}$ $= 1140\text{d.}$
$\therefore$ 53 days : 365 days
1140d. : $\frac{745}{3}$d. $\Big\}$ :: £100 : sum required.
$£100 \times \frac{365}{53} \times \frac{18126}{1140 \times 73} = 25 \times 6 = \underline{£150}$. Ans.

4. (*a*) 2 yrs. 63 days. $= 793$ days.
(*b*) £24 14s. $3\frac{1}{2}\text{d.} = 5931\frac{1}{2}\text{d.} = \frac{11863}{2}\text{d.}$
$\therefore$ 793 days : 365 days
£325 : £100 $\Big\}$ :: $\frac{11863}{2}$: rate in pence,
$\frac{11863}{2}\text{d.} \times \frac{365}{793} \times \frac{100}{325} = 840\text{d.} = \underline{£3\ 10\text{s.}}$ Ans.

5. 1 day : 365 days
£1000 : £100 $\Big\}$ :: 2s. : interest p.c. in s.
$2\text{s.} \times \frac{365 \times 100}{1000} = 73\text{s.}$ $\underline{£3\ 13\text{s.}}$ Ans.

FEMALES.

1. $\frac{1}{2}$, $\frac{9}{20}$, $\frac{7}{15}$, $\frac{17}{30}$, $\frac{2}{3}$, $\frac{13}{20}$ have for L.C.D. 1260, and when reduced to same denominator $=$
$\frac{360, 378, 525, 612, 80, 675}{1260}$. Ans.

2. (*a*) $3\frac{2}{3} + 4\frac{3}{4} + 4\frac{1}{5} = 11\frac{40+45+48}{60} = 13\frac{13}{60}$ or $\frac{793}{60}$.
(*b*) $7\frac{9}{17} - 5\frac{2}{3} = 7\frac{35}{51} - 5\frac{34}{51} = 2\frac{1}{51}$ or $\frac{103}{51}$
(*c*) $94\frac{1}{2} + 4\frac{1}{3} = 98\frac{5}{6} = \frac{593}{6}$.
(*d*) Product of (*a*) and (*b*) divided by (*c*) $=$
$\frac{793}{60} \times \frac{103}{51} \times \frac{6}{593} = \frac{793 \times 17 \times 1}{3 \times 21 \times 789} = \underline{\frac{13481}{13671}}$. Ans.

3. $£1\frac{13}{16} \times 16\frac{1}{12} = £\frac{125 \times 411}{96 \times 25} = £\frac{8555}{384} = \underline{£21\text{s. } 8\text{s. } 1\frac{1}{2}\text{d.}}$ Ans.

4. The whole will be $£3740 \times \frac{5}{8} = £\frac{3740}{8} = \underline{£9973\ 6\text{s. } 8\text{d.}}$

Grammar.

1. (*a*) *whilst*—a subordinative temporal conjunction.
but—co-ordinative adversative ,,
when subordinative temporal ,,
and—simple co-ordinative ,,
(*b*) *mankind*—com. collective noun, plur., masc., obj. gov. by *of.*
amiable—adj., qual. *part.*
through—prep. gov. obj. case *conversation.*
on the contrary—adverbial phrase used independently.
grievance—abstr. noun, neut. sing. in opposition with *they.*
such—indef. adj., qual. subjects.
as—conj. = relative neut., plur., relative to *subjects*, nom. to are.
suited—complete part. of the reg. verb *suit*, qual. subjects.

Kind of Sent	Connective.	Subject.	Predicate.	Object:	Extensions.
(*a*) Adverbial	whi'st	they	diffuse	a cheerfulness	1. through conversation 2. at proper reasons
(*b*) Adverbial	when	they	infect	every discourse	with insipid mirth.
(*c*) Adjective		as = which	are not suited to it		

2. Prepositions:—He has been in London *since* Monday.
They were all lost *but* one.
We are all here *except* Tom.
Conjunctions:—Let us begin *since* he has not arrived.
They are often amiable, *but* sometimes they are disagreeable.
Except ye repent, ye shall all likewise perish.

Geography.

1. *See same question answered under First Year in this number of Magazine.*

3. JAMAICA. — *Physical Features.* — Surface very uneven, eastern part almost entirely filled with the *Blue Mts.*, which have many spurs. Western boundary of this mountain region formed by a *ridge* running across the whole island from S.E. to N.W. Greatest plain in the island called *Liguanea. Plain of Vere*, another level tract separated from the former by a low range of hills, numerous valleys, but all very narrow. Limestone caverns occur. Jamaica is well watered with rivers, rivulets, and springs. None of the rivers navigable except the *Black River.*

Climate exceedingly hot on lower plains along the southern coast. Two rainy and two dry seasons. Earthquakes frequent, hurricanes less frequent than in the other West India islands.

Productions.—Staple articles of export—sugar, coffee, pimento, maize, tobacco, cinchona cultivated since 1867. All kinds of tropical products.

Inhabitants.—Africans and their descendants, Coolies, and Europeans—at present about thirty-two blacks to every white—half a million in all.

History.—Discovered by Columbus 1494—possessed by Spain till 1655—captured by the English—conspiracy of slaves 1745—revolt of Maroons 1795—another negro insurrection 1865. After that year it became a crown colony.

History.

1. Constantius having gone to Britain to quell a disturbance between two "Counts of the Saxon shore," was the last emperor to reside in the country. He died at York (306), where his son Constantine assumed the title of Cæsar. Constantine is believed to have had a share of British blood through his mother Helena.

2. Canute the Dane was the son of Sweyn who conquered the kingdom from Ethelred the Unready. Canute, by a vote of the States convened at London, was appointed to the vacant throne 1017, after the death of Edmund Ironside, with whom he had shared the kingdom. By Canute the country was divided into four earldoms—*Northumberland, Mercia, East Anglia,* and *Wessex*.

3. In the reign of King John, Stephen Langton stood forth as the champion against the Crown of the liberties of all sorts and conditions of men. To Langton, along with Marshal, Earl of Pembroke, are we indebted most deeply for the privileges which for so many centuries we have possessed. The list of demands agreed on by the barons was embodied in the Great Charter signed by King John at Runnymead (1215).

Composition.

Definition.—Timber-trees are those which can be cut into great planks of wood; some trees grown for their timber, others for their beauty or fruit.

Kinds of Native Timber-trees.—Oak, elm, beech, ash, and fir, are the common English timber-trees.

Oak.—One of our largest and most useful trees—thick trunk—rough bark—green irregular leaves—massive branches—seeds called acorns, on which pigs and squirrels feed—of slow growth—attains full size in about 100 years—bark used for tanning—wood for shipbuilding, pulpits, pews, carved work; even the sawdust used by the dyer.

Elm.—Next to the oak for beauty—grows to great height—leaves of a beautiful glossy green during early spring—generally grown to form avenues—wood suited for water-wheels, bottoms of ships, large stakes for embankments, carving—the leaves are food for cattle.

Beech.—A noble-looking tree—rounded leaves—smooth mottled bark—large knotted roots—large woods of it in several parts of the country—fruit called *beech mast*, food for deer, squirrels, and pigs—wood very durable, used by the turner for washing bowls, bed-posts, large screws, and all kinds of furniture.

Ash.—A large tree, but not so bushy as elm or beech—smooth bark—light coloured leaves which come late in spring and fall early—seeds winged—wood strong and tough, used for plough handles, shafts of pickaxes, etc., spokes of wheels for waggons, carts, and agricultural implements.

Fir.—The most generally useful of all the timber-trees—often forms extensive forests—grows in the bleakest and most exposed situations—leaves like spikes and ever-green, of a feathery appearance—seeds packed in cones in hundreds. Scotch fir or wild pine gives us the wood known as *deal*—very easily worked—made into joists, floors, stair-cases, window-frames, doors, shelves—trees sawn into planks, where felled, by water-mills—firs usually grow tall, and are thus well adapted for masts of ships. Turpentine flows from firs in the form of juice, which is collected in troughs and put into casks. Pitch and tar also got from the fir.

Euclid.

1. A *straight line* is that which lies evenly between its extreme points.

A *plane superficies* is that in which, any two points being taken, the straight line between them lies wholly in that superficies.

An *obtuse angle* is that which is greater than a right angle.

A *circle* is a plane figure contained by one line which is called the circumference, and is such that all straight lines drawn from a certain point (called the *centre*) within the figure to the circumference are equal to one another.

A *regular polygon* is a rectilineal figure contained by more than four equal straight lines.

Parallel straight lines are such as are in the same plane, and which being produced ever so far both ways do not meet.

An *axiom* is a proposition so simple that the truth of it is admitted without proof.

2. Prop. 6, Book 1.

3. Prop. 24, Book 1.

Music.

1.

Pluperfect 4th. Perfect 5th. Minor 2nd. Imperfect 5th. Minor 6th.

2.

3.

THIRD YEAR.

Pupil Teachers at end of Third Year, *if apprenticed on, or after, 1st May,* 1878; **and Pupil Teachers at end of Fourth Year,** *if apprenticed before that date.*

Three hours and a-half allowed.

Arithmetic.

MALES.

1. How much tea at 4s. 9d. a lb. must I give for a cwt. and a quarter of sugar at 9½d. a lb. in order to gain 5 per cent. by the exchange?

2. If an oz. of wrought silver be worth 5s., what percentage of 1 lb. Troy should be the weight of a cup for which I am asked to pay £2 16s. 6½d.?

3. If by laying out £2,490 in 3½ per cents. I can get an income of £96 16s. 8d. per annum, what is the price of the stock per cent.?

4. If £3,500 were invested in 3½ per cents. at 98, what income would be derived from the investment per month, supposing interest to be paid monthly?

5. The standard silver coin of this realm is made of a metal of which 92·5 per cent. is pure silver and the rest alloy. Out of 1 lb. Troy of this mixed metal are coined 66s. What then is the value at the Mint of an oz. of standard silver, and what of an oz. of pure silver, and what quantity of alloy is there in a 5s. piece?

FEMALES.

1. If 10 cannon, which fire 3 rounds in 5 minutes, kill 270 men in 1½ hours, how many cannon, which fire 5 rounds in 6 minutes, will kill 500 men in 1 hour at the same rate?

2. What are the values of ·203125 qrs., and ·73625 bush. of corn?

3. Express 12s. 6½d., 15s. 9¾d., and £4 13s. 4½d. as decimals of £1.

4. Required the exact value of ·75 of 6s. 8d. — 1·84375 of 4s. + 3·9796 of 2s.

Grammar.

1. What is the derivation of the word *transitive*, and how is that derivation connected with the use of the words *transitive, intransitive*, in grammar?

2. 'When I came to my castle I fled into it *like one pursued:* whether I went over by the ladder or *went* in at the hole which I called a door, I cannot remember; *no, nor could I remember the next morning;* for never frighted hare fled to cover, or fox to earth, with more terror of mind *than I* to this retreat.'

DEFOE.

(*a.*) Analyse the above passage from '*when I came*' to '*next morning.*'

(*b.*) Parse the words in italics.

Geography.

1. Draw a full map of our possessions in South Africa and the countries bordering on them.

2. Give full notes of a lesson on 'The River Jordan.'

One hour allowed for Females, two hours and a half for Males.

History.

1. Who was the mother of Henry VII. and what title did he bear before he ascended the throne?

2. There have been four Queens Regnant in England; give their names, parentage, and dates, and sketch the character of one of them.

3. What led to the declaration of American Independence in 1776?

Penmanship.

Write, in large hand, as a specimen of copy-setting, the word *Apprehensive.*

Write, in small hand, as a specimen of copy-setting, *The Metropolitan Street Improvements Act.*

Composition.

Write from memory the substance of the passage read to you by the Inspector.

Euclid

[All generally understood abbreviations for *words* may be used, but symbols of *operation*, such as –, +, ×, are not admissible.]

1. Straight lines which are parallel to the same straight line are parallel to each other.

2. Describe a parallelogram equal to a given square, and having an angle equal to half a right angle.

3. Equal triangles upon equal bases in the same straight line, and towards the same parts, are between the same parallels.

Algebra.

1. Multiply $-2xy+4x^3-y^2$ by $3y^2-2xy+4x^2$, and divide $-91a^5b^2x^9$ by $-13b^2x^3$.

2. Reduce to lowest terms $\frac{85(20a^4+a^2-1)}{102(25a^4+5a^3-a-1)}$

3. Solve the equations :—

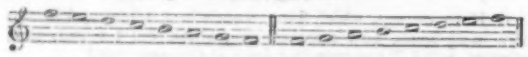
(1.) $-\cdot1x+\frac{x-7\cdot655}{\cdot23}=\cdot7$.

(2.) $\frac{x-3}{x-2}+\frac{x-4}{x-3}=2$.

Music.

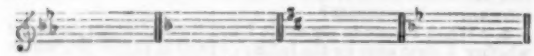
A quarter of an hour allowed for this paper.

1. Complete the following (by inserting the necessary sharps or flats) as a descending and ascending diatonic minor scale of F (*Fa*). Mark the places of the semitones.



2. Write a measure, of rests only, in each of the kinds of time indicated by the following signatures.

3. Write over each of the following the name of the major scale, and under each that of the minor scale of which it is the signature.



ANSWERS.—THIRD YEAR.

Arithmetic.

MALES.

1. $\left.\begin{matrix}57\text{d.} & : & 9\frac{1}{2}\text{d.} \\ 105 & : & 100\end{matrix}\right\}$ :: 140 lbs. : x lbs. tea

$140 \text{ lbs.} \times \frac{105}{114} \times \frac{100}{9\frac{1}{2}} = \frac{2800}{19} = \underline{147\frac{7}{19} \text{ lbs.}}$ Ans.

2. £2 16s. 6½d. = $\frac{1321}{480}$d. which divided by 60d. will give the No. of ozs. required, *i.e.* $\frac{1321}{480}$ oz. and this fraction represented as the percentage of 1 lb. or 12 ozs. Troy =

$\frac{1321}{480} \times \frac{100}{12}$ or $\underline{\underline{22\frac{41}{72}\%}}$. Ans.

3. £96½ : £3½ :: £2490 : price of £100 stock

£2490 × $\frac{2}{7}$ × $\frac{2}{83}$ = £90. Ans.

4. $\left.\begin{matrix}£98 & : & £3500 \\ 12 \text{ mos.} & : & 1 \text{ mo.}\end{matrix}\right\}$ :: £3½ : monthly income

£7 × $\frac{3500}{98}$ × $\frac{1}{12}$ = £10 8s. 4d. Ans.

5. (*a*) 12 oz. of standard silver = 66s.

∴ 1 „ „ „ = 5s. 6d.

(*b*) Now since $\frac{92\cdot5}{100}$ or $\frac{37}{40}$ of an oz. of pure silver = 5s. 6d. (not reckoning alloy) ∴ the value of the whole oz., will be 5s. 6d. × $\frac{40}{37}$ or 5s. 11$\frac{31}{37}$d.

(*c*) And since there are $\frac{5}{11}$ of an oz. of alloy, or 18 dwts. in 5½., then in a 5s. piece there must be 18 dwts. × $\frac{5}{5\frac{1}{2}}$ or

$\frac{18 \times 10}{11} = \underline{16\frac{4}{11} \text{ dwts.}}$ Ans.

FEMALES.

1. $\left.\begin{matrix}5 \text{ rounds} & : & 3 \text{ rounds} \\ 5 \text{ min.} & : & 6 \text{ min.} \\ 270 \text{ men} & : & 500 \text{ men} \\ 1 \text{ ho.} & : & 1\frac{1}{2} \text{ ho.}\end{matrix}\right\}$ :: 10 cannon : x cannon,

10 cannon × $\frac{3}{5}$ × $\frac{6}{5}$ × $\frac{500}{270}$ × $\frac{1\frac{1}{2}}{1}$ = 20 cannon. Ans.

2.

(*a*)	(*b*)
·203125 qrs.	·73625 bush.
8	4
1·625 bush.	2·945 pks.
4	
2·5 pks.	

1 bush. 2½ pks. Ans. 2$\frac{945}{1000}$ pks. Ans.

3.

(*a*)	(*b*)	(*c*)
12 | 6·75d.	12 | 9·75d.	12 | 4·5d.
20 | 12·5625s.	20 | 15·8125s.	20 | 13·375s.
£·628125	£·790625	£4·66875

4.

	shillings.
·75 of 6s. 8d. = ¾ of 6·6s. =	5·0000
+ 3·9796 of 2s. =	+ 7·9593
	12·9593
− 1·84375 of 4s. =	− 7·375
	5·5843s.
	12
	7·012 d.

∴ exact value = 5s. 7$\frac{1}{80}$d. Ans.

Grammar.

1. *Transitive* is derived from the Latin *transire*, 'to go across,' the action as it were passing over from the *doer* to the object; in *in*-transitive verbs the action does *not* thus pass over, hence the name.

2. (*a*)

No.	Kind of Sent.	Connective.	Full Subject.	Predicate.	Completion of Pred.	Extension of Predicate.
1.	Adverbial.	When	I	came	to my castle	into it (*place*)
2.	Principal.		I	fled		like one pursued (*manner*)
3.	Noun (object).	Whether	I	went	over	by the ladder (*means*)
4.	„ „	or	(I)	went	in	at the hole (*place*)
5.	Adjective (to 4).		I	called	which (direct obj.)	
					a door (indirect obj.)	
					(3, 4, 5, form object)	
6.	Principal.	(and)	I	cannot remember	„ „	
7.	Principal.	nor (= and not)	I	could (not) remember		the next morning (*time*)

NOTE.—*No* is equivalent to such a sentence as—*I could not remember.*

(*b*) *like*—adverb modifying *fled* (some consider *like* a prep.).
one—indef. pron. masc. sing. obj. gov. by (*to*) (some would say gov. by *like*).
pursued—complete part. of the reg. verb *pursue*. qual. *one*.
went—intrans. verb, strong conj. *go, went, gone*, indic. past indef., 1st pers. sing. agreeing with *I*.
no—negative adverb equivalent to a sentence. (*See note to analysis.*)
nor—conj. (= and not) negative, connecting '*I cannot remember*,' and '*I could* (*not*) *remember*.'
could—auxiliary verb (defective) indic. past indef. 1st pers. sing. agreeing with *I*, and forming with the infinitive.
remember—the past indef. potential of the reg. trans. verb.
I—1st pers., pron., masc., sing., nom., subj. of *could*.
the next morning—adverbial phrase mod. *could remember* or *fled*.
the—def. art., or a disting. adj., qual. *morning*.
next—adj., superl. deg., *near, nearer, nearest* or *next*, qual. *morning*.
morning—abstr. noun, neut., sing., obj., gov. by (*on*).
than—comparative conj. connect. '*never frighted hare fled to cover*' and '*I* (*fled*) *to this* retreat.'
I—1st pers, pron. masc. sing., nom to (*fled*).

Geography.

2. RIVER JORDAN.—*Source*—Nearly in the latitude of Tyre, main sources situated among the Mountains of Anti-Lebanon—these feeders unite in Lake Bahr-Haleh.

Course and character—Flows southwards, feeding Lakes Samochonitis (Waters of Merom) and Gennesaret, and empties its waters into the Dead Sea—it is a swift, dark-coloured stream about 200 miles long, including windings, but in a direct course about 70 miles—numerous islets scattered along its course—which is also interrupted by about 27 rapids.

Valley of the Jordan—Hemmed in by a range of steep and lofty hills on both sides, gradually approaching as they go south. Thirty or forty feet below this greater valley lies a smaller one, forming the channel of the river, which, when swollen, completely fills it, and even overflows its borders. This lower valley has its edges covered with the most luxuriant vegetation, like a long oasis in a desert; from Sea of Tiberias or Lake Gennesaret, which is 328 feet below the level of the Mediterranean, the Jordan continues a rapid course to the Dead Sea, which is 3,000 feet below the same level.

Incidents—Crossing of Israelites—baptism of Jesus—other Biblical notes.

History.

1. Henry VII. was the *son of Margaret Beaufort*, great-grand-daughter of John of Gaunt. The title which he bore before his accession to the throne was *Earl of Richmond* through his father, Edmund Tudor.

2. Queen Mary, daughter of *Henry VIII.* and *Catharine of Aragon* (A.D. 1553—1558).
Queen Elizabeth, daughter of *Henry VIII.* and *Anne Boleyn* (A.D. 1558—1603).
Queen Anne, daughter of *James II.* and *Anne Hyde* (A.D. 1702—1714).
Queen Victoria, daughter of *Edward D. of Kent*, and *Victoria of Saxe-Coburg* (1837).

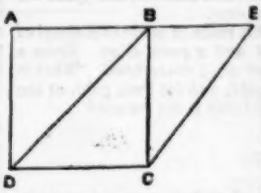
Anne was a strict Protestant of the High Church School, and always attached to the Tory party in politics. She was diligent and careful in public business, though of moderate ability; good-hearted, but rather weak in submission to her favourite the Duchess of Marlborough. She had high notions of the royal perogative, but, in the main, governed according to the nation's will expressed through Parliament. Privately, she was a lady of simple and homely tastes and habits.

3. George Grenville having imprudently extended the *Stamp Act* to the North American Colonies, they objected to it on the principle of *no taxation without representation*. Though the Stamp Act was repealed, yet Parliament maintained their right to tax the Colonies, which was the great point in dispute. In course of time other taxes were imposed, and among these a tax was laid upon tea, which the British Government insisted upon. The colonists refused to make use of it or any imported goods until the duty was removed. In 1773, a band of men threw a cargo of tea into Boston harbour, and to punish the people of this town the English Government shut up the port and suspended the Charter of Massachusetts. This last act was fatal, and, eventually, in 1775, the first outbreak took place at Lexington.

Euclid.

1. Prop. 30, Bk. I.

2.



Let ABCD be a given square. Bisect it by the diagonal BD. Now since CD equals CB the angle CDB, = angle CBD, and therefore, each of them is half a right angle. Through C draw CE parallel to DB, and produce AB to E. Then DBEC is the parallelogram required; for it is equal to the square ABCD, because it is on the same base DC, and between the same parallels DC and BE, and it has the angle BDC equal to half a right angle.—Q. E. F.

3. Prop. 40, Bk. I.

Algebra.

1. (*a*)
$$\begin{array}{r} 4x^2 - 2xy - y^2 \\ 4x^2 - 2xy + 3y^2 \\ \hline 16x^4 - 8x^3y - 4x^2y^2 \\ - 8x^3y + 4x^2y^2 + 2xy^3 \\ 12x^2y^2 - 6xy^3 - 3y^4 \\ \hline 16x^4 - 16x^3y + 12x^2y^2 - 4xy^3 - 3y^4 \end{array}$$

(*b*) $\dfrac{-91a^3b^2x^3}{-13\ b^2x^3} = \underline{7a^3}$. Ans.

2. $\dfrac{85\,(20a^4+a^2-1}{102\,(25a^4+5a^3-a-1)} = \dfrac{17\times5\,(5a^2-1)\,(4a^2+1)}{17\times6\,(5a^2-1)\,(5a^2+a+1)}$

G.C.M. $= 17\,(5a^2-1)$ $\therefore$ L.T. $= \underline{\left(\dfrac{5\,(4a^2+1}{6\,(5a^2+a+1)}\right)}$. Ans.

3. (1) $\dfrac{x-7\,655}{\cdot23} - \cdot1x = \cdot7$

Multiplying by 23000

$$1000x - 7655 - 23x = 161$$
$$1000x - 23x = 161 + 7655$$
$$977x = 7816$$
$$x = \underline{8} \text{ Ans.}$$

(2) $\dfrac{x-3}{x-2} + \dfrac{x-4}{x-3} = 2$

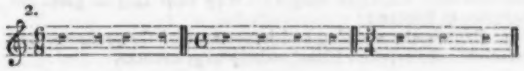
Multiply by L. C. denominators $(x-2)\,(x-3)$

$$\therefore x^2 - 6x + 9 + x^2 - 6x + 8 = 2x^2 - 10x + 12$$
$$2x = 5$$
$$x = \underline{2\tfrac{1}{2}}. \text{ Ans.}$$

Music.

1.

2.



3.

FOURTH YEAR.

Pupil Teachers at end of Fourth Year, *if apprenticed on, or after, 1st May,* **1878; and Pupil Teachers at end of Fifth Year, if apprenticed before that date.**

Three hours and a-half allowed.

Arithmetic.

MALES.

1. If bar iron which cost in making £41 13s. 4d. per ton be sold at a loss of 5½ per cent., what price did it fetch per cwt.?

2. I invest £18,150 in 3 per cents, at 90¼, and on their rising to 91 transfer my money to 3½ per cents, at 97½; what increase do I make thereby in my annual income?

NOTE.—*We is equivalent to such a sentence as—I could not remember.*

3. What would be the purchase money of a row of houses producing a rental of £3,228 3s. 4d. at the rate of 8¾ per cent.?
4. Find the true present worth of, and discount on, £226 1s. 11d. due 7 months hence, at 4¾ per cent.
5. 'The standard gold coin of this realm is made of a metal of which 22 parts in 24 are pure gold and 2 parts alloy. From a pound troy of this metal are coined 46$\frac{2}{3}$ sovereigns.' What is the value per oz. of (*a*) standard gold, and (*b*) pure gold, at the Mint? and what percentage of the latter is the former?

FEMALES.

1. To what sum will £725 accumulate in 4 years at 5 per cent. compound interest?
2. A man and a boy working together can do ·61 of a piece of work in two days; the man working by himself could have done the work in 4 days; how many days will it take the boy working by himself to do it?
3. How many heifers must a person buy at £8 10s. each, so that after allowing 3s. 8d. for the food of each for a week, he may then, by selling each of the lot at £9 4s. 7d., gain £43 2s. 5d.?
4. What fraction of $\frac{3}{17}$ of 11 qrs. 5 bus. 2 pks. is equal to $\frac{2}{3}$ of 9 qrs. 1 bus. 1½ pk.?

Grammar.

1. Are Anglo-Saxon and English different languages; or what is their relation to one another?
2. 'The Batavian territory, *conquered* from the waves and *defended* against them by human art, was in extent little superior to the principality of Wales; but *all that* narrow space was a busy and populous hive, in which new wealth was *every day created*, and in which vast masses of old wealth *were hoarded*.'

MACAULAY.

(*a*) How many different sentences are contained in the above? Assign each to its proper class.
(*b*) Parse the words in italics.
3. When should the word '*the*' be considered as an adverb? Give instances.

Geography.

1. Give full notes of a lesson on 'The River Jordan.'
2. Describe fully the Arctic Ocean, and the seas, bays, gulfs, and straits connected with it.

Draw a map to illustrate *one* of your answers.

History.

1. How many of our kings have borne the name of Edward? Give their dates, and sketch the character of one of them.
2. When, where, and between what nations were the battles of the Nile and Trafalgar fought? Why were they of great importance to England?
3. Explain the meaning and importance of the parliamentary principle: No supplies before redress of grievances.

Penmanship.

Write, in large hand, as a specimen of copy-setting, the word, *Apprehensive*.

Write, in small hand, as a specimen of copy-setting, *The Metropolitan Street Improvements Act*.

Composition.

Describe any interesting scene you have witnessed, or excursion you have made in your last holidays.

Euclid.

[All generally understood abbreviations for *words* may be used.]

1. Bisect a triangle by a line drawn through a given point in one of the sides.
2. If a straight line be divided into any two parts, the rectangles contained by the whole and each of the parts are together equal to the square on the whole line.
3. To divide a given straight line into two parts, so that the rectangle contained by the whole and one of the parts shall be equal to the square on the other part.

Algebra.

1. Prove the rule for finding the product of two fractions.

Divide $\frac{4a'(a^2-x^2)}{3b(c^2-x^2)}$ by $\frac{a^2-ax}{bc+bx}$

2. Find the square root of—

$$x^6+4x^5+10x^4+20x^3+25x^2+24x+16.$$

3. Solve the equations:—

(1) $\frac{1}{ab-ax}+\frac{1}{bc-bx}=\frac{1}{ac-ax}$

(2) $\begin{cases}\frac{x+2}{7}+\frac{y-x}{4}+2x-8\\ \frac{2y+3x}{3}+2y=3x+14\end{cases}$

(3) $45x^2-25x=1000.$

Mensuration.

1. The sides of a triangle are in the proportion of the numbers 13, 14, 15; and the perimeter is 70 yards. Find the area.
2. A circle is 4 ft. in circumference; find the area of a square described about it.

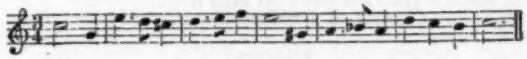
Music.

A quarter of an hour allowed for this paper.

1. Write the upper tetrachord of C (*Do*) minor in every form with which you are acquainted. Mark the places of the semitones and augmented intervals.

2. Write, under each of the following pairs of notes, the name and quality (major, perfect, diminished, or other) of the interval it forms.

3. Transpose the following into D (*Re*).



ANSWERS.—FOURTH YEAR.

Arithmetic.

MALES.

1. Selling price of 1 cwt. = $\frac{1}{20}$ of £41$\frac{3}{8}$ × $\frac{94\frac{1}{2}}{100}$
„ = £$\frac{1\frac{3}{8}}{1}$ × $\frac{7}{8\frac{1}{2}}$ × $\frac{1}{20}$
„ = £$\frac{7}{136}$
i.e., £1 19s. 5$\frac{1}{17}$d. Ans.

2. 1st income = £18150 × $\frac{13}{365}$ = 50 × 12 = 600 0 0
2nd „ = £$\frac{18150\times91}{90\frac{3}{4}}$ new stock × $\frac{3\frac{1}{2}}{97\frac{1}{2}}$
„ = £$\frac{18150\times364\times7}{363\times195}$
= £$\frac{1960}{3}$ *i.e.*, 2nd income = 653 6 8
∴ diff. of income is £53 6 8 Ans.

3. £100 of house property raised £8¾
∴ £1 is raised from $\frac{100}{8\frac{3}{4}}$
And 3228½ „ £$\frac{19369}{6}\times\frac{400}{35}$
„ „ *i.e.*, £$\frac{110680}{3}$ = £36,893 6s. 8d.

4. $£4\frac{3}{4} \times \frac{7}{12} = \frac{19 \times 7}{4 \times 12} = £\frac{133}{48}$ interest of £100 for 7 mos.

$\therefore £\frac{133}{48}$ is the discount on $£100\frac{133}{48}$ or $£\frac{4933}{48}$

and the $£\frac{4933}{48} : £\frac{133}{48} :: £226\frac{23}{40} :$ discount required.

$$£\frac{4933}{48} \times \frac{133}{4933} = £\frac{11 \times 133}{240} = \underline{£6\ 1s.\ 11d.}$$

$\therefore$ the pres. val. of £226 1s. 11d. $= \underline{£220\ 0s.\ 0d.}$

5. (*a*) $46\frac{2}{3} \div 12 = £\frac{46\ 14s.\ 6d.}{12} =$

$\underline{£3\ 17s.\ 10\frac{1}{2}d.}$ price of 1 oz. Standard gold.

(*b*) Now since there are 11 oz. of *pure* gold in 12 oz. of *Standard* we shall have (neglecting the value of the alloy) the value of 1 oz. *pure* gold at the Mint $= \frac{1}{11}$ of £46 14s. 6d. $= \underline{£4\ 4s.\ 11\frac{5}{11}d.}$ Ans.

(*c*) To find the percentage that (*a*) is of (*b*)

we have $\frac{£3\ 17s.\ 10\frac{1}{2}d. \times 100}{£4\ 4s.\ 11\frac{5}{11}d.} = \frac{1869 \text{ halfpence} \times 100}{2038\frac{1}{2} \text{ halfd.}} =$

$\frac{186900}{2038\frac{1}{2}} = \underline{\frac{2}{3}\frac{7}{7}\frac{4}{4}} = 91\frac{2}{3}$ p.c. Ans.

FEMALES.

1. 5 per cent. of interest $= \frac{1}{20}$ of principal per annum.

		£725
		36·25
Amt. at end of 1st year	=	761·25
		38·0625
„ „ 2nd „	=	799·3125
		39·965625
„ „ 3rd „	=	839·278125
		41·96390625
„ „ 4th „	=	881·24203125
		20
		4·84025s.
		12
		10·0875d.

$\therefore$ £725 accumulates to $\underline{£881\ 4s.\ 10\frac{7}{10}d.}$

2. *Man* and *boy* do $\frac{5}{18}$ or $\frac{11}{36}$ in 2 days, *i.e.*, $\frac{11}{72}$ in 1 day.
The man alone does $\frac{1}{8}$ in 1 day, *i.e.*, $\frac{9}{72}$

$\therefore$ the boy alone in 1 day does $\frac{1}{72}$
And so the boy will do the whole in 18 days.

3. Each heifer costs him, in all, £8 13s. 8d.
„ is sold for ... £9 4s. 7d.
$\therefore$ he gains on each ... 10s. 11d.
$\therefore$ £43 2s. 5d. will be gained on £43 2s. 5d. ÷ 10s. 11d.
„ „ „ 10349d.
131d.
i.e., 79 heifers. Ans.

4. $\frac{3}{5}$ of 9 qrs. 1 bush. $1\frac{1}{2}$ pks. $= \frac{3}{5}$ of $293\frac{1}{2}$ pks. $=$
$\frac{6}{17}$ of 11 qrs. 5 bush. 2 pks. $= \frac{6}{17}$ of 374 pks.
$\frac{2}{3}\frac{2}{3}\frac{0}{0} \div 110 = \frac{2}{3}$. Ans.

Grammar.

1. *Modern English* is only a somewhat altered form of the language brought into England by the Saxons and Angles, and which, in its early form, is commonly called *Anglo-Saxon*. The grammatical framework of Modern English is still purely Anglo-Saxon. As regards its form Anglo-Saxon had a much greater number of inflexions than modern English. In A. S., nouns had five cases and their different declensions, adjectives were declined, and had three genders, &c. The greater part of these inflexions were dropped in course of time and their functions are now served by such words as prepositions and auxiliary verbs. This change is what is meant when it is said that ancient English —Anglo-Saxon —was an *inflected* and *modern English* an *analytic* language.

2. (*a*.)

KIND OF SENT.	SENTENCES.
1. Principal.	The Batavian territory, conquered from the waves and defended against them by human art, was in extent little superior to the principality of Wales.
2. Principal, *in adversative co-ordination with* (1).	But all that narrow space was a busy and populous hive.
3. Adjective, *to 'hive' in* (2.)	In which new wealth was every day created.
4. Adjective, *to 'hive' in* (2).	(And) in which vast masses of old wealth were hoarded.

(*b*.) *conquered*—complete part. of reg. trans. verb *to conquer*, qual. *territory*.
defended—complete part. of reg. trans. verb, *to defend*. qual. *territory*.
all—indef. num. adj. qual. *space*.
that—disting. adj. qual. *space*.
every—distrib. adj. qual. *day*.
day—abstr. noun. neut., sing. obj. (*of time*) gov. by (*on*).
created—complete part. of the reg. trans. verb to *create*, forming with *was*, past indef. indic. passive.
were—auxiliary v. of voice, *am*, *was*, *been*, indic. past indef. 3rd pers. plur. agreeing with *masses*, and forming with the complete part.
hoarded—past indef. indic. passive voice.

3. The word '*the*' is considered an adverb when it stands before comparatives, as:—'*The* sooner, *the* better.' '*The* nearer the bone, *the* sweeter the meat.' '*The* more *the* merrier.' It is the old *ablative* or *instrumental* case of the *demonstrative adjective* '*the*.'

Geography.

1. *See same question answered* '*Third Year*' *of this number of Magazine.*

2. The Arctic Ocean is the name given to the expanse of water which extends from lat. 66° 30′ N. to the North Pole. It communicates with the Atlantic by a wide opening between Greenland and Norway, and by a narrow channel on the west of Greenland, called Davis Strait. With the Pacific it communicates through Behring's Strait. The Arctic Ocean is nearly circular in form, and is almost land-locked by the northern coasts of the Old and New Worlds. The ice-bound condition of this Ocean has utterly baffled all attempts hitherto made to penetrate to the Pole. It encroaches on Europe in the *White Sea*, on Asia in the Gulfs of *Kara*, *Obi*, *Yenesei*. Between Asia and Alaska is the Strait of Behring. The northern shores of America are extremely indented and crowded with islands, thus forming numerous gulfs, bays, straits, and channels, the principal being *Baffin Bay*, extended by *Smith Sound*, *Kennedy*, and *Robeson Channels*, *Lancaster Sound*, *Barrow Strait*, *Melville Sound*, and *Banks Strait*; *Coronation Gulf*, *Dease Strait*, *Simpson Strait*, *Gulf of Boothia*, *Fury* and *Hecla Strait*, *Fox Channel*, and *Hudson Strait*.

History.

1. Six of our Kings have borne the name of Edward :—

Edward I.	reigned from	1272 till 1307.
Edward II.	„	1307 „ 1327.
Edward III.	„	1327 „ 1377.
Edward IV.	„	1461 „ 1483.
Edward V.	„	in 1483 for 3 mos.
Edward VI.	„	from 1547 till 1553.

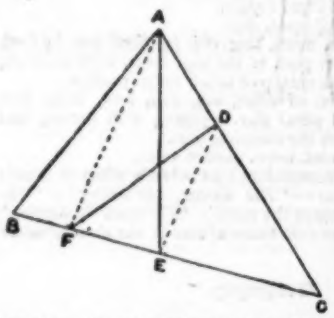
Edward VI. was a pious boy, of feeble health, well instructed, and warmly in favour of the Reformed doctrines. During his short life he was regarded by the Protestant party with the hopeful affection given to one who promised to be a wise and able, if not a vigorous ruler.

2. The battle of *the Nile* was fought *August 1st*, 1798, in *Aboukir Bay*, west of the mouths of the Nile, *between the French and the English fleets*. The gaining of this battle by the British Admiral Nelson prevented Napoleon from carrying out his grand scheme for the conquest of our Indian Empire. The battle of *Trafalgar* was fought *Oct. 21st*, 1805, off that cape, which is south of Cadiz in Spain. Here *the English* fleet, under Nelson, defeated *the combined French and Spanish fleets*, and thus for ever destroyed all fears of a French invasion of England.

3. Members of the House of Commons have both a right to object to the expenditure of certain moneys and to oppose the granting of supplies altogether until all grievances are redressed. The rules of the House give members absolute power in this respect, and they have frequent opportunities of exercising this right. Thus, when the House is going into Committee of Supply, any member has the liberty of rising in his place and objecting to their going into Committee, on the ground that the people at large or of his constituency are suffering from any grievance or wrong which he thinks the Crown should be made to redress before any money is granted for carrying on the government of the country. Of course a majority of votes would be required to carry his motion; but generally speaking now-a-days members are quite satisfied with merely stating their grievance. However, it is customary for responsible ministers to promise that these wrongs will be inquired into. It is evident from this that the people possess great power over the Crown, and that no grievance of any consequence can remain unredressed.

Euclid.

1.



Let D be the given point. Bisect the side BC in E. Join AE, DE, and through A draw AF parallel to DE. Join DE. DE shall be the straight line required.

Because the triangles DFE, AED are upon the same base DE and between the same parallels, they are equal to one another; but the triangle DGE is common to both, and therefore the remainders AGD GFE are equal. Now the triangles ABE AEC are equal, being upon equal bases and having a common vertex. Take away from each the parts FGE AGD respectively and the remainders AGFB DGEC are equal, and so, by adding AGD to AGFB, and GFE to DGEC, the whole ADFB is equal to the whole DFC. That is the straight line DF bisects ABC.—Q.E.F.

2. Prop. 2. Bk. II.

3. Prop. 11. Bk. II.

Algebra.

1. (*a*) The rule for finding the product of two fractions is, 'Multiply the numerators of the fractions together for a new numerator and the denominators for a new denominator.'

For if $\frac{p}{q}$ and $\frac{r}{s}$ be the given fractions, let us suppose that

$$\frac{p}{q} = m, \text{ and } \frac{r}{s} = n.$$

then $p = qm$, and $r = sn$;

$\therefore pr = qsmn$;

dividing these equals by qs we have

$$\frac{pr}{qs} = mn;$$

but $mn = \frac{p}{q} \times \frac{r}{s}$, and $\frac{pr}{qs} = \frac{p \times r}{q \times s}$;

therefore $\frac{p}{q} \times \frac{r}{s} = \frac{p \times r}{q \times s}$ *i.e.*, $\frac{\text{product of numerators.}}{\text{product of denominators.}}$

(*b*) $\frac{4a(a^2-x^2)(bc+bx)}{3b(c^2-x)(a^2-ax)} = \frac{4a(a+x)(a-x)(c+x)b}{3b(c-x)(c+x)(a-x)a} =$

(after striking out factors) $\frac{4(a+x)}{3(c-x)}$. Ans.

2. x^2 | $x^6+4x^5+10x^4+20x^3+25x^2+24x+16$ (x^3+2x^2+3x+4

x^6

$2x^3+2x^2$ | $4x^5+10x^4$

$4x^5+4x^4$

$2x^3+4x^2+3x$ | $6x^4+20x^3+25x^2$

$6x^4+12x^3+9x^2$

$2x^3+4x^2+6x+4$ | $8x^3+16x^2+24x+16$

$8x^3+16x^2+24x+16$

3. (1) $\frac{1}{a(b-x)} + \frac{1}{b(c-x)} = \frac{1}{a(c-x)}$.

Multiplying by $ab(b-x)(c-x)$

$\therefore bc-bx+ab-ax=b^2-bx$

$bx-bx-ax=b^2-bc-ab$

$ax=ab-b^2+bc$

$x=\frac{b}{a}(a-b+c)$.

(2) (*a*) $\frac{x+2}{7} + \frac{y+x}{4} = 2x-8$

(Multiplying by 28) $4x+8+7y-7x=56x-224$

$59x-7y=232$

(*b*) $\frac{2y+3x}{3} + 2y = 3x+14$

$2y+3x+6y=9x+42$

$3x-4y=-21$

From (*a*) $236x-28y=928$

,, (*b*) $21x-28y=-147$

by subtraction $215x = 1075$

$x = 5$

And by substitution $y = 9$

2. Dividing each side by 5,

$9x^2-5x=200$

Dividing by 9, $x^2-\frac{5}{9}x=22\frac{2}{9}$

Completing square $x^2-\frac{5}{9}x+\frac{25}{324}=\frac{7200+25}{324}=\frac{7225}{324}$

Taking root $x-\frac{5}{18}=\pm\frac{85}{18}$

$x=\frac{5}{18}\pm\frac{85}{18}=5$ or $-4\frac{1}{2}$. Ans.

Mensuration.

1. 1st side is $\frac{1}{3}$ of 210 ft. or 65 ft.

2nd ,, $\frac{1}{3}$,, ,, 70 ,,

3rd ,, $\frac{1}{3}$,, ,, 75 ,,

$\frac{65+70+75}{2} = 105$ ft. half the sum of sides.

$\therefore$ Area = the square root of

$105 \times (105-65) \times (105-70) \times (105-75) =$

$\sqrt{105 \times 40 \times 35 \times 30} = \sqrt{4,410,000} =$

2100 sq. ft. or 233 sq. yds. 2 ft. Ans.

2. Area of described square = square of the diameter of the inscribed circle.

Diameter = 4 ft. $\div$ 3·1416 and

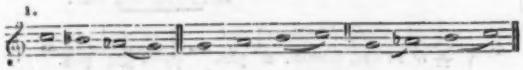
$\therefore \left(\frac{4}{3{\cdot}1416}\right)^2$ = area of square

$= \frac{16}{9{\cdot}86965}$ ft.

i.e., 1·621 sq. ft. Ans.

Music.

1.



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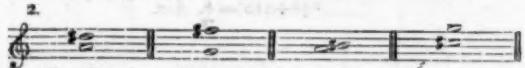
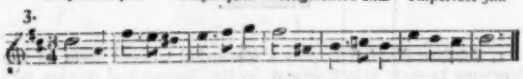


Pluperfect 4th. Major 7th. Augmented 2nd. Imperfect 5th.

3.



Query Column.

☞ **As the answer to a single question often entails an expense six or seven times greater than the cost of the complete key to any of the Arithmetics or Algebras ordinarily used, the Proprietor of this Journal would be glad if students confined themselves to questions, the full working of which is not published in the form of a 'key.'**

RULES.

1. Each correspondent is restricted to *one question.*

2. No query can be answered unless accompanied by the real name and address of the sender, not necessarily for publication, but as a guarantee of good faith and for facility of reference.

3. Replies will not be sent through the post.

4. Correspondents are requested to write *legibly*, and on one side of the paper only.

5. Correspondents wishing us to recommend books for any (other than the ordinary Government) Examinations, or to answer any questions concerning that Examination, must, in all cases, send a copy of Regulations up to date.

6. Queries must reach the office *not later than the 15th of the month*, or they cannot be attended to in the following issue.

*** All communications for this column should be addressed

'*The Query Editor*,'
The Practical Teacher,
Pilgrim Street, Ludgate Hill,
London, E.C.

1. FOURTH-YEAR P. T., Skelmanthorp.—The Syllabus you can order through any bookseller. Write to Messrs. W. Stewart and Co., Holborn Viaduct Steps, for their catalogue of Certificate and Scholarship publications.

2. GEORGE BURGE, Hodnet.—We make no exception to our rules, not even 'for this once.' The B.A. questions set at London are only published in the Calendar for the year after. The price of each Calendar is 4s. No answers given. Messrs. Stewart, perhaps, have a book that would suit you in this particular.

For *Co-ordinate Geometry* read Todhunter's Treatise (Macmillan, 7s. 6d.). No Key published, but answers are given. Only the chapters on the Straight Line, not including Abridged Notation, and the Circle.

3. JESSIE, Glasgow.—We do not reply to anonymous correspondents. Please let us have your name and address. In consideration of your munificent offer, the Editor has consented that a short account of the Unitary System shall appear in the body of the Journal, probably in our next issue. We direct your attention, and your amorous friend's also, to this for further information.

4. H. A. D., Iron Acton.—Cassell's *Educational Year-Book* will supply you with a better list of Training Colleges than we could. Publisher, Cassell.

5. J. BAGSHAW, Ashbourne.—You are certainly not wrong in considering the clauses as complementary. Thanks for calling our attention to this.

6. POLLY.—Don't you see that by an inadvertence the *first amount* was substituted for the principal? Yours is the correct answer.

7. O. H. F., Dover.—We regret that your proposal cannot be carried out, as the pressure upon our space is so great. Next year we hope to have a section of special benefit to Certificate Candidates. If there is any question in last year's papers that you cannot work, avail yourself of the *Query Column*.

8. R. E. T., Aberdare.—At what rate per cent. *Compound Interest* will £750 amount to £826 17s. 6d. in 2 years?

The amount of £M for x years at y per cent is £M $\left(1+\frac{y}{100}\right)^x$

If this be £P.

$$M\left(1+\frac{y}{100}\right)^x = P$$

$$\therefore \left(1+\frac{y}{100}\right)^x = \frac{P}{M}$$

$$\therefore y = 100\left\{\left(\frac{P}{M}\right)^{\frac{1}{x}} - 1\right\}$$

This at once suggests the method.

P is £826½. M is £750. $x=2$.

$$\frac{P}{M} = \frac{6615}{6000} = \frac{441}{400}$$

The square root of this is $\frac{21}{20}$.

$$\therefore y = 100\left(\tfrac{21}{20} - 1\right) \text{ or } 5.$$

At first sight this method seems Algebraical, but it will be found that the principles involved are solely Arithmetical.

The above method is always the best for Compound Interest. Thus interest on £100 for 10 years at 5 per cent. is £100 $\{(1{\cdot}05)^{10} - 1\}$, for 14 years. £100 $\{(1{\cdot}05)^{14} - 1\}$ and $(1{\cdot}05)^{14}$ will be found to be very nearly equal to 2, so that the Interest for 14 years is very nearly equal to the Principal. It is *always* the best method when the answer is required approximately only.

9. H. TAYLOR, Herne Hill.—A stone dropped down a pit is heard to strike the bottom 7 seconds after it left the hand. Find the depth of the pit, supposing the velocity of sound to be 1,120 feet per second.

Let x feet be depth of pit. Sound reaches the ear (supposed at level of pit's mouth) in $\frac{x}{1120}$ seconds, and therefore the stone took $7 - \frac{x}{1120}$ seconds to fall. Now the depth fallen in any time is proportional to the square of the time from commencement, and a stone falls 16 feet in the first second.

$\therefore$ the depth fallen $= x$

$$= 16\left(7 - \frac{x}{1120}\right)^2$$

(Dynamically $s = \frac{1}{2} ft.^2$ and f here is g).

$$x = \left(28 - \frac{x}{280}\right)^2$$

$$\frac{x^2}{78400} - \frac{x}{5} + 784 = x$$

$$\therefore x^2 - 94080x + 61465600 = 0$$

$$\therefore (x - 47040)^2 = 2151296000$$

$$x - 47040 = \pm 46382 \text{ nearly.}$$

The upper sign gives for the depth of the pit 93,422 feet.

This is an answer which, though it satisfies the equation $s = \frac{1}{2} ft.^2$ is an Algebraical solution only, and is inconsistent with the conditions.

The other answer—658—is the correct one approximately enough.

10. T. BINFIELD wishes to know, on behalf of a subscriber in Ceylon, how to pronounce the outrageously barbarous names of some wretched places which the Query Editor is ignorant enough not to have heard of. To show the tribulations through which we, in our ignorance of Tamil and dialects, have to pass, we lay the question open for general competition.

"How do you pronounce Akiba, Kshatriyas, Jawari, Ragi, Crore?"

No one is allowed to make more than a dozen guesses at each.

Your decimal should be read: ten, decimal, cipher, cipher, eight, one, *i.e.*, 10·0081.

What are called "proportional compasses" would help you in your map-drawing. Obtain of any mathematical instrument maker at 2s. 6d.

11. NITOR, Cherrybank.—The data are insufficient, as you yourself remark. We think, perhaps, that the original rate of one of the travellers should have been given, or a relation between their two rates.

12. R. BLACK, Prudhoe-on-Tyne.—If the estimated annual value of the property in a certain parish consist of the yearly rent paid to the landlord, together with the rates, and the rates be calculated upon the rent after a reduction of 30 per cent.; find the rateable value of a tithe-rent charge, the calculated annual value of which is £884 per annum, when the rates amount to 3s. in the pound. (*Barnard Smith.*)

Suppose the rents to be £1. After a reduction of 30 per cent., *i.e.*, $\frac{3}{10}$, this becomes $\frac{7}{10}$. On this the rates are 3s. in the £, *i.e.*, $\frac{3}{20}$. Hence the amount of the rates is $\frac{3}{20}\times\frac{7}{10}$ or $\frac{21}{200}$. Hence the annual value is $£1+£\frac{21}{200}$ or $£\frac{221}{200}$. Hence the rents are $\frac{200}{221}$ of annual value, *i.e.*, $£\frac{200}{221}$ of 884; *i.e.*, £800. To get the rateable value we must make a reduction of 30 per cent. on this, *i.e.*, it is $£\frac{7}{10}\times 800$ or £560.

13. YARICO, Bridlington.—You must excuse us if, not understanding your data, we fail to get an answer at all resembling yours.

14. ADA.—The Diatonic Scale has two modes—major and minor. Any good elementary work on music will show how the sequences of tones and semitones recur in these respective modes, and also the melodic changes made in the minor ascending scale from its more normal descending form. The definition you have adopted applies only to the major and not to the minor Diatonic Scale.

15. W. C. U.—For a Pupil Teacher in the second year it would require some five or six years' devotion to the study and practice of music—taking into consideration the fulfilment of other duties—to obtain a B.M. degree. Unless you have proved aptitude for music and resolute determination to carry on this lengthened course of study, don't think for several years about this B.M. degree. Mozart could obtain it in less time, but then Mozart had no sums to do. Besides, you may not be a Mozart. Work as diligently as you can at music as at everything else, but 'aim not too high.' Study well and the degree will come in time, but don't think about it yet. All needful information can be obtained from the officials of the Universities.

16. SUBSCRIBER, Rippingale.—A pupil-teacher must serve four years before he can try for the Scholarship Examination.

17. R. GIBBONS, Stockport.—If a certain field will graze two oxen and three horses for 21 days, or three oxen and two horses for $19\frac{1}{2}$ days, compare the appetite of an ox and a horse.

In this question, since there are only two data, we are not meant to take any account of the growth of the grass.

2 oxen and 3 horses for 21 days.
3 oxen and 2 horses for $19\frac{1}{2}$ days.

Hence it is obvious that if x and y be the appetites of an ox and a horse respectively

$$(2x+3y)\ 19\tfrac{1}{2} = (3x+2y)\ 21$$
$$\text{or } (2x+3y)\ \tfrac{39}{2} = (3x+2y)\ 21$$
$$\text{or } (2x+3y)\ 29 = (3x+2y)\ 31$$
$$\text{or } 58x+87y = 93x+62y, \text{ or } 25y = 35x$$
$$5y = 7x \quad x:y :: 5:7.$$

The methods involved are purely Arithmetical. You did not tell us whether Arithmetic or Algebra was intended.

18. Several Queries from Cheap Street, Sherborne, are unanswered, because the Querist did not favour us with his name.

19. J. WORMALD, Lofthouse.—

Solve $(x-2)(x-3) = 3(5x+14)$

$$x^2-5x+6 = 15x+42$$
$$x^2-20x = 36$$
$$x^2-20x+100 = 136$$
$$x-10 = \pm\sqrt{136} \qquad x = 10\pm 2\sqrt{34}$$

20. J. B. M., Meikleour.—Arnold's *Greek Prose Composition*. Same publisher as his other work, and same price, we believe.

Parry's *Greek Grammar*. Longmans, 3s. 6d.

You are a little hypercritical on poor Query No. 9 of the June number. You say our construction is impossible, our "directions cannot be carried out." Instead of making $\angle CAD = \angle ADB$ on the side on which you have drawn it, try the other side and you will agree with us.

21. P. T., Cotmanhay.—Given that the square of 10129 is 102596641, find the square of 101293 without going through the operation of squaring.

We know from an easy theorem in Algebra that

$$(a+b)^2 = a^2+2ab+b^2$$
$$\therefore (101293)^2 = (101290+3)^2$$
$$= (101290)^2+6(101290)+9$$
$$= 10259664100$$
$$\ 607740$$
$$\ \underline{\qquad\quad 9}$$
$$10260271849$$

22. KAPPA, Weston-super-Mare.—There is no difficulty in your passage, or we would translate it for you. Try yourself and send us your efforts to be corrected, if you like, but do not attempt to make us into a "key."

23. H. C. S., Ashford.—The inscription is old Spanish. We cannot help you.

24. R. HALL, Weston-super-Mare.—A man bought 63 sheep and sold $\frac{5}{7}$ of them at a profit of 15 per cent; $\frac{1}{7}$ at a profit of 50 per cent., and the remainder at a loss of 25 per cent. What did he pay for the sheep if his gain was £3 17s. on the whole?

$\frac{5}{7}$, *i.e.*, 28 at a profit of 15 per cent.
$\frac{1}{7}$, *i.e.*, 9 at a profit of 50 per cent.
The remainder 26 at a loss of 25 per cent.

Hence, by the ordinary rule of percentages, profit per cent. on the whole is

$$\frac{28\times 15+9\times 50-26\times 25}{28+9+26}$$
$$\text{or } \frac{420+450-650}{63} \quad \text{or } \tfrac{220}{63}$$

But we are told that his profit was £3 17s., and we have just proved that this is $\frac{220}{63}$ per cent. of the price he gave for them.

$\therefore$ price is

$$\frac{63\cancel{0}}{\cancel{2}_{1}}\times\frac{77\ 7}{2\cancel{0}} \text{ or } \frac{441}{4} \text{ or } £110\ 5s.$$

25. X. K. D., Woking.—The price of gold is £3 17s. 10½d. per oz. A composition of gold and silver weighing 18 lbs. is worth £637 7s., but if the proportions of gold and silver were interchanged it would be worth only £259 1s. Find the proportion of gold and silver in the composition and the price of silver per oz.

Add the two compositions together. It is evident that we now have 18 lbs. of gold and 18 lbs. of silver, worth altogether £896 8s.

Hence 18 ozs. of gold and 18 ozs. of silver are worth £56 0s. 6d.

Hence 1 oz. of gold and 1 oz. of silver are worth £3 2s. 3d.

But since 1 oz. of gold alone is worth £3 17s. 10½d. your data are absurd.

26. SCRUTATOR, Dunstable.—Find the side of a square inscribed in a semi-circle whose radius is 5 feet. (Pupil Teachers' Examination, June, 1879.)

It is obvious, by considerations of symmetry, that one side of the square must lie along the bounding diameter of the semi-circle, and that the middle point of this side must lie at the centre of the circle.

If C be the centre, and PNN'P' the square, NCN' being along the bounding diameter

$$CP^2 = CN^2+PN^2 = \left(\frac{NN'}{2}\right)^2+PN^2$$
$$= \frac{PN^2}{4}+PN^2 = \frac{5PN^2}{4}$$
$$\therefore PN^2 = \frac{4CP^2}{5} = \frac{4\times 25}{5} = 20$$
$$\therefore PN = 2\sqrt{5}$$

Your writing promises to be fairly neat, not business-like enough, no dash about it. Still it is so much better than we usually receive that we cannot help repeating what the old Latin poet used to say, '*Ah! si sic omnia!*'

27. H. C. ASHTON, Cardiff.—In any triangle the square described on the base is equivalent to the rectangles contained by the two sides and their segments, intercepted from the base by perpendiculars let fall upon them from the opposite extremities.

This is so vaguely worded that it took us some time to see what it meant. We presume it may be interpreted as follows:—

ABC is a triangle, BE perpendicular to AC, CF perpendicular to AB.

$$BC^2 = BA.BF + CA.CE$$

For the sake of simplifying the figure, suppose the angle at A to be obtuse.

Then, since BEC is a right angle, and also BFC, BEFC may be inscribed in a circle.

$$\therefore\ EA.AC = BA.AF$$

But $CA.CE = CA(CA+AE) = CA^2 + CA.AE$

and $BA.BF = BA(BA+AF) = BA^2 + BA.AF$

$$\therefore\ CA.CE + BA.BF = CA^2 + BA^2 + 2BA.AF = BC^2 \quad \text{(Euc. II. 12.)}$$

The proof is almost exactly the same when BAC is acute, and when it is a right angle, of course the theorem is identical with I. 47.

28. WESTWARD HO, Bideford.—The area and any two sides of any triangle being known, to ascertain the third side.

We know that if a, b, c be the sides, $2s$ their sum, and Δ the area of the triangle

$$\Delta = \sqrt{s(s-a)(s-b)(s-c)}$$

$$\text{or } 16\Delta^2 = (a+b+c)(b+c-a)(c+a-b)(a+b-c)$$

$$= 2b^2c^2 + 2c^2a^2 + 2a^2b^2 - a^4 - b^4 - c^4$$

This may be written

$$a^4 - 2a^2(b^2+c^2) + (b^2-c^2)^2 + 16\Delta^2 = 0$$

Solving this quadratic in a^2

$$a^2 = b^2 + c^2 \pm \sqrt{(b^2+c^2)^2 - (b^2-c^2)^2 - 16\Delta^2}$$

$$\text{Hence } a = \sqrt{b^2+c^2 \pm 2\sqrt{b^2c^2 - 4\Delta^2}}$$

This gives the third side, but of course it is absurd to learn this as a formula. You must work it out with each separate example. There is no simpler way.

29. HALIFAXIAN, Halifax.—A right pyramid, 12 feet high, stands on a square base, of which the sides are each 10 feet, find the position of a plane, parallel to the base, which divides the pyramid into two equal parts.

It is a fundamental theorem in Mensuration and Solid Geometry that similar figures are to one another in the triplicate ratio of their homologous edges (analogue to VI. 19) or of any two lines similarly drawn in them. If then a plane is drawn, cutting off a little pyramid at the top, which is half the original and similar pyramid, it follows that its perpendicular height is to the perpendicular height of the original pyramid as $\sqrt[3]{\frac{1}{2}} : 1$

Hence the plane must be drawn at a distance of $\frac{12}{\sqrt[3]{2}}$ feet from the vertex, or $6 \times \sqrt[3]{4}$ feet.

30. W. SEYMOUR, South Shields.—The sum of four numbers and the sum of their squares are each equal to unity. Show that five times the sum of their fourth powers differs by unity from four times the sum of their fifth power.

In other words

$$a+b+c+d = 1 \quad (1)$$

$$a^2+b^2+c^2+d^2 = 1 \quad (2)$$

Show that

$$5(a^4+b^4+c^4+d^4) = 4(a^5+b^5+c^5+d^5) + 1$$

Square (1) and subtract (2)

$$ab+ac+ad+bc+bd+cd = 0$$

Hence $(x-a)(x-b)(x-c)(x-d)$

$$= x^4 - x^3(a+b+c+d) + x^2(ab+ac+\ldots) - x(abc+abd+acd+bcd) + abcd$$

$$= x^4 - x^3 - x(abc+abd+acd+bcd) + abcd$$

Take logarithms of both members after dividing throughout by x^4

$$\log\left(1-\frac{a}{x}\right) + \log\left(1-\frac{b}{x}\right) + \log\left(1-\frac{c}{x}\right) + \log\left(1-\frac{d}{x}\right) = \log\left(1 - \frac{x^3+x(\ ) - abcd}{x^4}\right)$$

$$\therefore \text{ if } e^n = a^n + b^n + c^n + d^n$$

$$\frac{e^1}{x} + \frac{e^2}{2x^2} + \frac{e^3}{3x^3} + \frac{e^4}{4x^4} + \frac{e^5}{5x^5} + \ldots = \left(\frac{x^3+px-abcd}{x^4}\right) + \tfrac{1}{2}\left(\frac{x^3+px-abcd}{x^4}\right)^2 + \tfrac{1}{3}\left(\frac{x^3+px-abcd}{x^4}\right)^3 + \ldots\ldots \text{where}$$

$$p = abc+abd+acd+bcd$$

Now equate the co-efficients of $\frac{1}{x^4}$ on both sides of this

$$\frac{e^4}{4} = -abcd + \frac{2p}{2} + \tfrac{1}{4};$$

Also equating the coefficients of $\frac{1}{x^5}$

$$\frac{e^5}{5} = -\frac{2abcd}{2} + \frac{3p}{3} + \tfrac{1}{5}$$

This is seen at once by writing

$$\frac{x^3+px-abcd}{x^4} \text{ as } \frac{1}{x} + \frac{p}{x^3} - \frac{abcd}{x^4} \text{ and}$$

picking out the respective coefficients.

$$\text{Hence } \frac{e^4-1}{4} = -abcd + p = \frac{e^5-1}{5}$$

$$\therefore\ 5(e^4-1) = 4(e^5-1)$$

$$\therefore\ 5e^4 = 4e^5 + 1. \qquad \text{—Q. E. D.}$$

There may possibly be a shorter way, but this is the one that naturally occurred to us.

31. R. S. O., Pontardawe.—A person bought a French watch, bearing a duty of 25 per cent., and sold at a loss of 5 per cent. Had he sold it for £3 more he would have cleared 1 per cent. on his bargain. What had the French maker for it? (*Barnard Smith.*)

He sold it at $\frac{95}{100}$ of its price.

Had he sold it for $\frac{96}{100}$, he would have got £3 more.

$$\therefore\ \tfrac{1}{100} \text{ of price} = £3$$

$$\therefore\ \text{Price} = £50$$

But there was a duty of 25 per cent. on the watch originally.

$\therefore$ The French maker had $\frac{1}{2}$ of £50, or £40 for it.

32. P. T., Newbury.—A person invests £18,150 in the 3 per cents. at 90¾, and, on their rising to 91, transfers to the 3½ per cents. at 97¼. What increase does he make thereby in his annual income?

Total capital after selling out in the 3 per cents. is

$$£\frac{91}{90\frac{3}{4}} \times 18150 \text{ or } £\frac{91\times 4}{363} \times \frac{\overset{50}{\cancel{18150}}}{1} \text{ or } £18{,}200$$

Now in the second stock

£97¼ produces £3½

£1 ,, £$\frac{7}{389}$

£18200 ,, £$\frac{7}{389} \times \overset{280}{\cancel{18200}}$

$$= £\frac{1960}{3}$$

$$= £653\ 6s.\ 8d.$$

In the first stock

£90¾ produces £3

£1 ,, £$\frac{4}{363}$

£18150 ,, £$\frac{4}{363} \times \overset{150}{\cancel{18150}}$

$$= £600$$

Hence there is an increase of £53 6s. 8d.

33. H. B. B., Abergavenny.—Any good Physical Geography would show you. It depends on longitude, of course. For instance, Paris is 2°20′23″ E. Long., and as the sun rises in the East and goes through the whole 360° degrees in a day of 24 hours, Paris has noon

$$\frac{2°20'23''}{360°} \times 24 \text{ hours before Greenwich,}$$

Or approximately, neglecting the seconds of angular measurement,

$$\frac{2\frac{1}{2}}{6} \times 24 \text{ minutes}$$

Or $\frac{25}{6}$ min., say 9½, to make up for the 23″ neglected.

Thus, when noon at Greenwich, it is 11h. 50½m. A.M. at Paris

34. JE NE SAIS PAS, Lees.—You are very indefinite. You do not say whether you wish for an elementary or advanced book, whether you have done a course of Exercises or not, or whether you know any French worth speaking of.

Under the circumstances we cannot make you a better recommendation than Chardenat's *Advanced Exercises*.

35. T. A. MUMMERY, Folkestone.—The parallel sides of a trapezoid are respectively 16 and 20 feet, and the perpendicular distance between them is 5 feet. It is required to divide the trapezoid into two equal trapezoids. Find the distance of the dividing straight line from the shorter of the parallel sides. (Todhunter's *Mensuration.*)

Let ABCD be the trapezoid, DC being the longer side, and AE, BF be perpendiculars on DC from A and B, namely, E adjacent to D and F adjacent to C. Suppose the line that is to bisect the trapezoid cut AD, AE, BF, BC respectively in G, H, K, L.

Let $AH=BK=x$

Then $GH:AH::DE:AE$

$GH:x::DE:5$

Also $KL:x::FC:5$

$\therefore GH+KL:x::DE+FC:5::20-16:5$

$::4:5$

$$\therefore GH+KL=\frac{4x}{5}$$

But $HK=AB=16$

$$\therefore GL=16+\frac{4x}{5}$$

$$\text{And area } GABL=\frac{x}{2}(AB+GL)$$

$$=\frac{x}{2}\left(32+\frac{4x}{5}\right)=x\left(16+\frac{2x}{5}\right)$$

But this area is half of the whole, *i.e.*,

$$=\tfrac{1}{2}(16+20)5=9\times5=45$$

$$\therefore x\left(16+\frac{2x}{5}\right)=45$$

$$2x^2+80x=225$$

$$2x^2+80x-225=0$$

$$x=\frac{-80+\sqrt{6400+1800}}{4}=\frac{-80+10\sqrt{82}}{4}$$

Now by tables $\log 82=1\cdot9138139$

$\log\sqrt{82}=\cdot9569069$

$\therefore \sqrt{82}=9\cdot0553$, etc.

$$\therefore x=\frac{10\cdot553}{4}=2\cdot638 \text{ feet.}$$

The negative root to the quadratic equation is, of course, irrelevant.

36. G. W. KENT, Leamington.—The receipts of a railway company are apportioned in the following manner:—49 per cent. for working expenses, 10 per cent. for the reserved fund, a guaranteed dividend of 5 per cent. on one-fifth of the capital, and the remainder, £40,000, for division among the holders of the rest of the stock, being a dividend at the rate of 4 per cent. per annum.

Find the capital and the receipts.

£40,000 is a dividend of 4 per cent. on $\frac{4}{5}$ of stock

£1,000,000 is 100 per cent. of $\frac{4}{5}$ of stock

i.e., is $\frac{4}{5}$ of stock

$\therefore$ Stock, or capital, is £1,250,000

On $\frac{1}{5}$ of this, *i.e.*, £250,000, 5 per cent. is paid.

$$\therefore \frac{£250000}{20} \text{ or } £12,500 \text{ is paid.}$$

Hence receipts are apportioned thus

59 per cent. railway management

£52,500 being the remainder for dividends

$\therefore$ £52,500 is 41 per cent. of receipts.

$$\therefore \text{receipts are } \frac{£5,250,000}{41}$$ which doubtless comes, as you say, to £128,048 15s. $7\frac{1}{41}$d.

37. CHELT, Sheffield.—Two planes, inclined at one-third and two-thirds of a right-angle to the horizon respectively, meet at the top and slope opposite ways. If bodies of equal weight fall down these planes, starting at the same instant, show that the motion of their centre of gravity is the same as if one of them were to remain at rest and the other to fall vertically. (Magnus' *Mechanics.*)

Consider the position of the bodies at any instant h after starting. Let us call the bodies A and B.

$$\text{A has fallen } \tfrac{1}{2}(g\sin 30°)h^2 \text{ or } \frac{gh^2}{4}$$

$$\text{B } \quad \text{,,} \quad \tfrac{1}{2}(g\sin 60°)h^2 \text{ or } \frac{gh^2}{4}\sqrt{3}$$

Hence it will be seen at once that A is distant $\frac{gh^2\sqrt{3}}{4\cdot2}$ from the bounding line of the planes, B $\frac{gh^2}{4}\frac{\sqrt{3}}{2}$ from the same line, *i.e.*, they are equidistant. Hence the centre of gravity is always in this line, *i.e.*, it falls vertically from the ridge of the planes.

Also, the vertical height through which A has fallen is

$$\frac{gh^2}{8} \text{ and the similar quantity for B is}$$

$$\frac{3gh^2}{8} \textit{ i.e. } \frac{gh^2}{4}\cdot\sqrt{3}\times\frac{\sqrt{3}}{2}$$

$\therefore$ The centre of gravity has fallen through a vertical height

$$\frac{\frac{3gh^2}{8}+\frac{gh^2}{8}}{2} \text{ or } \frac{gh^2}{4} \textit{ i.e.}$$, just one-half the height that a body would fall freely in the time.

On referring to a figure it will be seen at once that this proves the proposition.

38. HOPE, Surrey.—Collins has a *Dictionary of Synonyms* that would help you very much in parsing. Price 1s., remarkably cheap.

'She hesitated, and then blushing sang the first song which was to do honour to the stranger who had that day arrived. Her rich voice for a time kept to the rhythm of the tune, but then, bursting through all restraints, she sang and at the same time composed regular periods of verse.'

39. E. CROSS, Faversham.—A person ascending vertically in a balloon lets fall a stone when at a given height ($=h$); find the time of the stone's reaching the ground, supposing the velocity of the balloon at the given altitude known ($=u$).

By ordinary formula

$$h=-ut+\tfrac{1}{2}gh^2$$

$$\therefore \tfrac{1}{2}gh^2-2ut-2h=0$$

$$t=\frac{1}{g}\left\{u\pm\sqrt{u^2+2gh}\right\}$$

Evidently the + value is the right one, the minus corresponding to a problem of slightly different enunciation, but leading to the same algebraical equation. You will not find it hard to enunciate this. Wait till next time for your other.

40. W. R., Sandsling.—Referring to our former figure (query 7, May), you will see that by Euc. VI. 8, $AB.BC=BD^2$

$$\therefore AB=\frac{BD^2}{BC}$$ and BD and BC are both known, so that AB is known.

This method is perfectly fair even in a purely Arithmetical Paper. You cannot expect to do a problem in Arithmetical Geometry or Mensuration without using Geometry.

In our previous solution we introduced Algebra because we never like to pre-suppose a higher knowledge of Euclid than is really absolutely necessary for the solution of the problem.

41. NEMO, Leamington.—

Find the G. C. M. of $x^4-2x^3+x^2-8x+8$ and $4x^3-12x^2+9x-1$

$$4-12+9-1\overline{)4-8+4-32+32}\,(1+1$$

$$\underline{4-12+9-1}$$

$$4-5-31+32$$

$$\underline{4-12+9-1}$$

$$7-40+33$$

Having now reduced one quantity to a quadratic function, we will finish the sum by factors.

$$7x^2-40x+33=(x-1)(7x-33)$$

Now $7x-33$ cannot divide $4x^3-12x^2+9x-1$

$\therefore x-1$ is G. C. M., if there is one at all, and it will be seen on inspection that $x-1$ divides both quantities.

42. A. E. S., Ealing.—The diameter of a square is the diagonal, not the width. It is a foolishly incorrect expression, if our opinion will comfort you.

43. NERO, Pontypridd.

Find a, b, c so that both $x^4+ax^3+bx^2+cx+1$ and $x^4+2ax^3+2bx^2+2cx+1$ are perfect squares.

(London, *First B.A., Pass.*, 1881).

Let $x^4+ax^3+bx^2+cx+1=(x^2+px+1)^2$

$$=x^4+2px^3+(p^2+2)x^2+2px+1$$

$$\therefore a=c=2p \quad b=p^2+2=\frac{a^2}{4}+2$$

The condition that the second expression should be a perfect square is evidently got by substituting

$2a$ for a, $2b$ for b, $2c$ for c

and is $2b=a^2+2$

But they are simultaneously squares

$$\therefore\ 8 = \frac{a^2}{4} + 2$$

$$2b = a^2 + 2$$

$$2b = \frac{a^2}{2} + 4$$

$$\therefore\ \frac{a^2}{2} = 2 \quad a = \pm 2 \quad b = 3 \quad c = \pm 2$$

Hence there are two sets of values

$$\left\{ \begin{matrix} 2, & 3, & 2 \\ -2, & 3, & -2 \end{matrix} \right\}$$

44. GILBERT.—No, a conjunction. Yes. Yes.

45. J. E. R., Sedgley.—There would seem to have been two Ermine Streets, and this fact will explain the discrepancy you name. The main and most important one ran from London to Lindum or Lincoln, and thence continued north to the great capital at York or Eboracum. This is the description which Dr. Collier gives as quoted by you. Probably the road from Pevensey, a natural landing-place for the Romans, to London was continuous with this, and might have been called by the same name. This gives rise to the second statement you quote. The other Ermine Street is more properly Irmin or Hermin Street, the second spelling being most correct. It ran, as the other two statements you quote say, from St. David's to Southampton. As to the former, its course is as well defined as any of the Roman roads, except Watling Street and Fosse Way. From Royston, a small village on G. N. R., midway between Hitchin and Cambridge, to Huntingdon it is the main coach road still, and a very good road it is. The name is Norse, for Cambridgeshire was the very centre of the Danish settlements in England during the ninth century. The original word is Eörme—bog earth. There is a small village on it called Ermingford, which, being interpreted, is the ford of the fen-man. This shows at once the locality through which the road passed. Hermin, on the contrary, is a Latin name.

46. FRANK GASKIN, Leamington.—A man invested a sum of money in 4½ per cent. stock, standing at 1½ per cent. premium, and allowed the investment to accumulate at simple interest. The stock went down in value for 9 years at the average rate of ¼ per cent., and then improved for 5 years at the rate of ½ per cent., at the end of which time he was able to draw out £49,387 10s. od. What was the original sum?

Total increase of value in stock $-\frac{9}{4} + \frac{5}{2} = \frac{1}{4}$

:: Selling value is $101\frac{1}{2} + \frac{1}{4} = 101\frac{3}{4}$

$\therefore$ Money increases by reason of investment $\frac{101\frac{3}{4}}{101\frac{1}{2}}$ times $= \frac{813}{812}$

Also the interest is 4½ % per annum.

$\therefore$ 14 × 4½ % for 14 years.

i.e., 63 %

$\therefore$ Money is now $1\frac{63}{100} = \frac{163}{100}$ of what it was

$\therefore$ The original sum was $\frac{406}{163} \times \frac{813}{812} \times 493871$

This is $\frac{£100}{163} \times \frac{£406}{813} \times \frac{98775}{x} = £\frac{40600000}{132219}$

$= £30,261$ 16s. 4d. nearly.

47. ELIAS T. JONES, Chevilog.—There is no difficulty in your sum, but we cannot spare space, as all such are clumsy to write down. Your best plan, if you really cannot manage it, is the following: draw a straight line about 14½ in. long, to represent distance from New York to San Francisco. Figure New York trains by a cross bar in red ink, San Francisco trains being in black. Take 1 in. to represent their day's journey and divide your line into inches, beginning at each end. You will have no difficulty then in seeing how to work the problem.

48. X. Y. Z., Mossley, and 'A SUBSCRIBER,' Nottingham.—We do not at present see solutions to your problems depending on the particular propositions by which you wish them to be proved, but we will try to let you have them by next month. Of course they are both easily worked by other propositions.

—o—

Scholarship Examination, 1881.

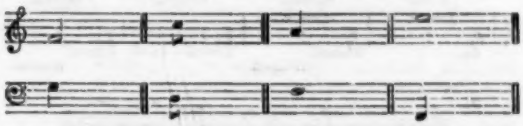
MALE AND FEMALE CANDIDATES.

Music.

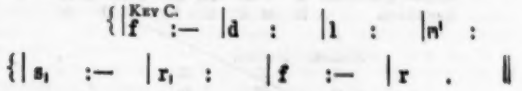
Three hours allowed for this and the School Management Paper.

The Tonic Sol-fa questions are printed in Italics. Candidates must keep *entirely* to one set of questions or the other *They are not permitted to answer more than* FOUR *questions.*

1. Write *over* each of the following notes its pitch name (A, B, *Do*, *Re*, or other); *under* it, its duration name (Crotchet, Quaver, or other); and *after* it, its corresponding rest.



1. *Write* OVER *each of the following notes its name with regard to its position in the scale, third, fifth, or other; and* UNDER *each the time names for notes and rests.*

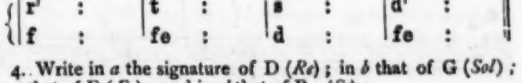


2. Complete the following as a scale of A or *La.*

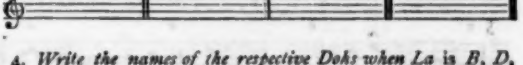
2. *Write a scale in the Lah mode; and one in the Ray mode.*

3. Write under each of the following pairs of notes its name (second, third, or other), and quality (major, perfect or other).

3. *Write under each of the following pairs of notes, its name (second, third, or other), and quality (major, perfect or other).*

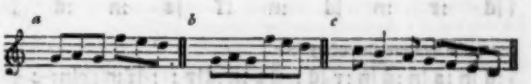


4. Write in *a* the signature of D (*Re*); in *b* that of G (*Sol*); in *c* that of F (*Fa*); and in *d* that of B (*Se*).

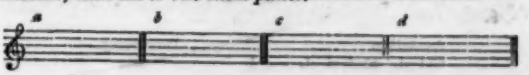


4. *Write the names of the respective Doh's when La is B, D, and G; and the names of the Lahs in Keys D, F, and B flat.*

5. Place time signatures before each of the following passages.



5. *Write a phrase in three-pulse measure, a phrase in four-pulse measure in secondary form, and a phrase in six-pulse measure, with one or two silent pulses.*



6. Write the scale of E (*Mi*) minor, descending and ascending.

6. *Write the upper part of the scale in the minor mode, ascending or descending, in all the forms with which you are acquainted*

ANSWERS.—SCHOLARSHIP EXAMINATION.

School Management.

MALE AND FEMALE CANDIDATES.

Three hours allowed for this Paper with that on Music.

Those who are or have been Pupil Teachers are not to answer more than one question in any Section. Candidates who have not been Pupil Teachers may answer any *seven* questions they think fit, except in Section I., from which only one subject may be selected for notes of a lesson.

No Candidate is to answer more than *seven* questions.

Section I.

Write full notes of a lesson on *one* of the following subjects:—

(1) Animals of the cat kind.
(2) Cardinal Wolsey.
(3) The river Mississippi.
(4) The manufacture of a cup, *or* a needle, *or* a boot.

Section II.

1. Why should young teachers be restricted from the use of corporal punishment (*a*) for the sake of their scholars? (*b*) for their own sake?

2. What bad habits are produced by careless correction of exercises, and by want of attention to home lessons?

3. Point out some of the ways in which school discipline may be useful in producing habits of ready obedience, and name some characteristic features of good discipline.

Section III.

1. Enumerate Froebel's seven gifts, and show the progressive nature of their lessons.

2. For what purposes are lessons on Form and Colour given to infants? Name the order in which the principal plane figures should be taught.

3. Write out some sentences containing five or six words which would present difficulties to each of the three lowest standards, and explain the progressive character of your method.

Section IV.

1. Select from the following passage words of irregular notation, and point out the irregularities:—

> When I met a man of pleasure, sacrificing every laudable improvement of mind, or of fortune, to mere sensual gratification; 'Mistaken man!' said I, 'you are providing pain for yourself, instead of pleasure; you give too much for your whistle.'
>
> If I see one fond of fine clothes, fine furniture, fine equipages, all above his fortune, and for which he contracts debts, and ends his career in prison; 'Alas!' I say, 'he has paid dear, very dear for his whistle.'

2. Describe a ball frame for teaching arithmetic, and show how it can be employed in teaching Short Division with or without remainders.

3. Write at full length an example in Compound Practice which will prove your process in this instance to be shorter than the ordinary method of Compound Multiplication.

Section V.

1. Show that a map differs from a picture, and explain how you would supply its dificiencies to a class beginning to learn Geography.

2. Explain how time may be economised in teaching Needlework by the use of the blackboard and other class apparatus.

3. Distinguish the uses of dictation and transcription lessons for children lately transferred from an infant school.

Section VI.

1. Write out brief notes of a lesson on 'Glass,' and explain your purpose in teaching the names of its qualities.

2. Make out a list of lessons on 'Common things,' illustrative of the pressure of the atmosphere, and give brief heads of *one* of such lessons.

3. Select points in the character of Lady Jane Grey, *or* Robert Bruce, *or* Nelson, that would be especially attractive to children, and write out some anecdote by which you would illustrate each point.

SECTION VII.

1. What directions would you give for the daily and weekly cleaning of a schoolroom? What additional cleaning is needed at longer intervals?

2. Show that, for some lessons, infant classes should be smaller in number than classes composed of older children, and that, for other lessons, one or more classes may be grouped.

ANSWERS.—SCHOOL MANAGEMENT.

SECTION I.

(1) Animals of the Cat kind.

I. PRINCIPAL VARIETIES.—Lion, tiger, leopard, panther, jaguar, wild cat, domestic cat. These include many of most powerful of the *Carnivora*, or flesh-eating tribe of animals.

II. STRUCTURE.—Specially adapted to suit their mode of life. A combination of strength, lightness, and agility. Bones, muscles, feet, claws, teeth, tongue, whiskers, eyes, and ears equally adapted to necessities of the animal.

(*a*) *Bones:* Of great strength, necessary for rapid movements of body; those of skull and vertebræ particularly so, for attachment of muscles and so as to resist shocks the animal might receive in leaps, etc.

(*b*) *Muscles:* Very hard and tough, turning edge of sharpest knife.

(*c*) *Feet and claws:* Feet provided with pads, enabling them noiselessly to approach prey. When resting on ground, claws enclosed in sheath; when stretched out, protrude, and are *long*, *sharp*, and strongly *curved*. (Draw diagram.) Claws protected when animal is walking; thus always sharp for seizing prey.

(*d*) *Teeth:* Formed only for biting and tearing, not chewing, having no flat surface necessary for grinding food.

(*e*) *Tongue:* Dry, rough; points turned backward. Can scrape every particle from bones of prey.

(*f*) *Whiskers:* Exactly same width as body; connected with sensitive nerves at base. Slightest touch enables animal to feel.

(*g*) *Eyes:* Large, round; pupil capable of great expansion, necessary at night.

(*h*) *Ears:* Movable, so as to incline towards prey in front, and foes behind.

III. HABITS AND CHARACTER.—Vary in different animals. Generally courageous, fierce, cunning, indolent, cautious, wary; torment prey; can be tamed. Come upon prey noiselessly; strike suddenly. Seek prey at night.

IV. DISTRIBUTION.—Some kind found in every continent except Australia. If time allow, name district of each.

(2) Cardinal Wolsey.

BIRTH AND EDUCATION.—Said by some accounts to have been son of a butcher; by others, of a private gentleman, of Ipswich. Born in 1471. Educated at Magdalen College, Oxford, graduating B.A. in 1486. Took orders and was appointed to rectory of Lymington, and made one of Henry VII.'s domestic chaplains in 1505.

HIS RISE AND GREATNESS.—Henry employed him in several delicate negotiations, especially in matter of marriage with Maximilian's daughter. He became successively Bishop of Tournay, 1513; Bishop of Lincoln, 1514; Archbishop of York, 1514. In 1515 he became Chancellor, holding the abbacy of St. Alban's, the bishopric of Durham and of Winchester, besides being made a cardinal and papal legate. His duties were performed with such ability that he became a great favourite with Henry VIII., and obtained even the applause of his enemies. He acquired great influence over the king, and succeeded in amassing great wealth, ostentatiously displaying it and provoking the envy of others. He aimed at becoming pope, but his efforts were twice frustrated.

HIS FALL.—He at first favoured Henry's design of divorce from Catherine; but when Anne Boleyn was chosen by the king to fill her place, his ardour cooled, and the king gradually lost patience with his favourite. The excessive taxation for the French wars, the haughtiness of his demeanour, and his inquisitional authority in matters of conscience had weaned the affections of the people. Every effort was made to secure his downfall, and listening to suggestions of his enemies, Henry caused Wolsey to be impeached, and to give up the great seal. Was banished to Esher, but afterwards allowed to retire to York.

HIS DEATH.—Was arrested in the winter of 1530 on a charge of treason, conveyed towards London; died at Leicester Abbey, 29th November. (Repeat his last words.)

HIS CHARACTER.—Ruling principle, ambition; proud, haughty, unscrupulous, ostentatious in display of wealth, a friend of education, and patron to men of science, literature, and the arts.

(3) River Mississippi.

Show on map, draw on blackboard as description is being given.

I. INTRODUCTION.—Note general direction and character of rivers in North America owing to position of mountain ranges. Mississippi, with Missouri, longest river in North America.

II. SOURCE.—Only 1500 ft. above level of sea. Rises in Lake Itaska, in State of Minnesota.

III. LENGTH AND COURSE.—2400 miles long; flows in southerly direction through splendid, well-wooded, well-cultivated valley or plain into Gulf of Mexico, passing through States of Minnesota and Iowa, and separating Missouri, Arkansas, Louisiana from Wisconsin, Illinois, Kentucky, Tennessee, and Mississippi.

Receives Missouri (2500 miles long), Arkansas, and Red Rivers on right bank; and Ohio, Wabash, Cumberland, and Tennessee on left.

Is navigable through whole of course, except 400 miles; from source of Missouri to mouth nearly 4000 miles. Delta at mouth laid under water, immense swampy tracts being formed.

IV. TOWNS ON BANKS.—Starting from source. *St. Paul*, limit of navigation, owing to falls of St. Anthony; *St. Louis*, at junction of Mississippi and Missouri, lumber and wheat trade, rival to Chicago; *Memphis*, cotton, rice, maize; *Vicksburg*, strongly fortified; *New Orleans*, great trade, next to New York, exports great quantities of cotton and other produce of Mississippi Valley.

On Missouri, *Jefferson City*, with oil springs.

On Ohio, *Pittsburg*, centre of coal and iron industries; *Cincinnati*, largest town in Western States, great trade.

(4) Manufacture of a Cup.

I. MATERIALS EMPLOYED.—Clay and flint. For finer kinds of earthenware a description known as *China clay*, found in large quantities in Cornwall, and being felspar in a partly decomposed state, is largely used, together with *steatite*, or soapstone, a species of mica found in Anglesea, calcined bones, and gypsum. Some makers use other ingredients.

II. PREPARATION AND MANUFACTURE.—Clay mixed with water thoroughly till of the consistency of cream, one pint weighing 26 ounces; operation called *blunging*.

Flints burnt to increase brittleness, rubbed against each other, and ground to fine powder in vat by rollers of felspar. After being further refined, flint, etc., mixed with clay, quantities of each varying according to article required, and ideas of manufacturer.

Mixture called *slip;* superfluous water removed in slip kiln; air-bubbles removed by *wedging* and *slapping*. (Explain.) Ready for *throwing*. Potter places piece of clay on wheel, and by means of foot turns wheel; forms cup with hand. Handle made and attached after turner has cut the cup to proper thickness. Now partly baked, called *biscuit;* glazed, painted, gilded, and rebaked. Common patterns applied from paper impression, finer kinds hand-painted.

III. WHERE MANUFACTURED.—North Staffordshire, Potteries, Stoke, Hanley, Burslem, Chelsea, Derby, and Worcester.

(4*b*) A Needle.

I. MATERIAL.—Soft steel wire procured from steel works at Sheffield or Birmingham, made in coils of great length.

II. MANUFACTURE.—Wire cut into pieces from two to four inches in length, called *ends*, sufficient to make two needles.

Made into bundles, heated and straightened. Next ground at both ends; points formed. Stamped, and groove made in which to place eyes. Eyes pierced by hand-presses worked by boys. Needles cut in two, and heads filed to proper shape. The bent needles are now straightened by being rolled between iron plates, and hardened by being heated and then suddenly cooled in water. Well scoured in loose bundles, in oil, emery, soap, and polishing putty; eyes drilled and points finished; finally polished and papered.

III. WHERE MANUFACTURED.—Redditch (Worcestershire), Gloucester, Whitechapel (London), Hathersage (Derby). Nearly 80,000,000 needles made at Redditch alone every week.

IV. LESSONS TO BE LEARNT.—Value of division of labour. Impossibility of one man performing all processes required in manufacture of such a small thing as a needle, over 100 hands being required in its economical manufacture.

(4c) A Boot.

I. MATERIALS EMPLOYED.—Leather of different kinds according to quality or sort of boot required (calf's skin, cow-hide, kid, morocco). Nails for heavy work.

II. MANUFACTURE.—By hand or machinery. Skins having been properly tanned and curried by the tanner and currier, the shoemaker cuts out the *tops* or upper part of the boots, and fastens the leather thus cut to a last—a piece of wood of the same shape as a foot. Round the lower edge of this top a strip of leather called a *welt* is sewn, and to this *welt* the sole of the boot is either sewn with waxed threads or pegged with brass nails. Two or three layers of leather are added to raise the heel, an inside sole is added, and the outside polished; *eyes* are added if laces are to be used. In the sole nails are hammered if the boots are needed for hard usage.

III. PLACES OF MANUFACTURE.—Leeds, Leicester, Nottingham, London, Stafford, and Wellingborough. Very fine kinds are imported from Paris.

IV. REMARKS.—Compare with ancient boots, and with modern covering for the feet used by some nations on the Continent, and give statistics of manufacture.

SECTION II.

1. (*a*) Children dislike punishment. If punished by a young teacher, they dislike him, and prove more intractable than before. They are aware that punishment by pupil teachers is against the laws of the school, and if this law is transgressed they are rendered still more obdurate, evil passions are roused, and their sense of respect for law and order is weakened. Resistance to punishment by pupil teachers may also end in physical injuries to the children.

(*b*) Because it is not their province. The head teacher only is placed *in loco parentis*. If allowed to punish, young teachers, finding this method the easiest, the readiest to hand, would forget the proper end of punishment, their finer feelings would become blunted, and a tendency to give way to passion would be fostered. Young teachers have not had sufficient experience to enable them to determine accurately what amount of punishment should be given, and defiance of their authority would possibly lead them to give more than was necessary, and they would become amenable to the law of the land. Their influence over the children would be weakened if permitted to give corporal punishment.

2. If exercises are carelessly corrected, children become careless in their preparation; the writing becomes slovenly, the books dirty, and untidiness generally will be observable in the children; faults in spelling become rooted, and habits of inattention are fostered.

Home lessons serve as a means of testing the success of the lessons of the previous day. If no attention is paid to the home work, a teacher is less able to tell the individual progress of each child. Finding that his home tasks are carelessly examined, a lad thinks that '*anyhow*' will do if they are done at all. Want of neatness, inaccuracy, and inattention during the day are direct results of carelessness respecting home lessons.

3. Some of the characteristics of good discipline are order, attention, diligence, prompt obedience, regularity, punctuality, respect for the feelings of others, and subordination. School discipline requires that prompt and willing obedience should be given to orders given by the teachers. As it is necessary that this should be insisted on, obedience becomes a habit with children. The feeling of ignorance, and of sympathy with its associates, leads a child to act as they act, and a command given to all is readily obeyed. Appeals, too, in the lessons given in school, are made to a child's sense of duty, and habits of obedience are fostered by the child's belief that what is required of it is right. Where the sense of duty is wanting, fear of punishment, or the hope of reward acts as an incentive to obedience. Fear of punishment, hope of reward, habit, appeals to sense of duty are some of the 'ways' in which school discipline is useful for the purpose of promoting habits of obedience.

SECTION III.

1. *First Gift.*—The soft ball. (A box containing six coloured balls, three primary, three secondary colours.)

Second Gift.—Ball—cube, and cylinder, the ball being uncoloured and hard.

Third Gift.—The cube divided once in every direction—that is, into eight smaller cubes.

Fourth Gift.—A cube divided into eight oblong planes.

Fifth Gift.—An extension of the third gift, the cube being divided into twenty-seven cubes; three of these are further subdivided into halves, and three into quarters.

Sixth Gift.—An extension of the fourth gift. Cube divided into thirty-six pieces, eighteen being similar, six being the same length and thickness but only half the breadth, and twelve the same breadth and thickness, but only half the length.

Seventh Gift.—Box containing pieces of board cut in different forms.

The ball is taken first as being best calculated to develop the faculties of a child, eyes, ears, and limbs being necessary to follow its movements; the second gift introduces the simplest form of figures with surfaces, the others follow with other figures which can be produced from one or other of those which have preceded, the more complex forms coming last.

2. Lessons on colour and form are given to children in order to train both their perceptive and intellectual faculties, to enable them to form correct impressions of things about them, and ultimately to represent things which have come under their observation. Lessons on form are a good introduction to the arts of writing and drawing. Lessons on colour to cultivate taste after teaching to discriminate the commonly occurring colours.

Square, oblong, and other four-sided figures.
Triangles of different kinds.
Figures with more than four sides.
Circle and other curved figures.

3. The difficulties experienced by children in respect to words in the three lowest standards arise from the fact that the English language has fewer signs than sounds. Consequently the same sign represents different sounds, and similar sounds are often represented by different signs. It has also signs which are not needed, and many words have letters which are silent. These difficulties should be introduced more sparingly in the first than in the second, and in the second than in the third standard.

The following sentences contain words which present difficulties to the three standards respectively:—

I. The lion is a cruel, *fierce beast*. He is sly and cunning. He *creeps* behind a bush, then crouches down, and springs on his *prey*. His *roar* is very terrible.

II. *Though* I walk *through* the valley and shadow of death I will fear no evil. He was compelled to *bow* his head as he went under the *bough* of the tree, which stood where the roads *were* narrowed very much.

III. I *advised* him to get the *advice* of a *physician* who lived in the *neighbouring* town, but he *preferred* to *accept* the advice of another.

SECTION IV.

1. Pleasure, instead. Taking *ē* as the name-sound for *ea*, these words are irregular.

Improvement, above: sound of *o* is irregular.

Said, pain, paid, say: diphthongs having no sound of their own, first taking *ĕ*, and others *ā*.

Whistle: *tle* having sound of *l*.

Debts: *b* silent.

One: sound of *o* irregular.

Sensual: *su* sounded like *shoo*.

Career, dear: *ee* and *ea* irregular, having sound of *ē*.

Pleasure, laudable, fortune, mere, are, whistle, fine, on account of silent *e*.

Gratification: sound of *tion*.

2. A ball frame is a frame of wood with wires running from side to side parallel with each other and the top and bottom of the frame at regular distances. Coloured beads in sections of three are placed on each of these wires, the frame generally being a little more than twice the width of that portion of the wires which is covered by beads, so as to allow the beads to be moved backwards and forwards. The colours are so arranged that no two wires shall have the same coloured beads directly underneath each other. The wires are generally twelve in number, and there are twelve beads on each wire.

Any number of beads may be counted out on the frame. These may then be subdivided into groups of two, three, or more, as desired, and if the divisor is contained an equal number of times there will be no remainder. If numbers are chosen which have no factors, then it will follow that the division cannot be equally performed, and there will be remainders.

3. Find the value of 235 acres 2 roods 20 poles, @ 12s. 6d. per rood.

Practice.

a. r. p.
235 2 20
4

942½ r.

At £1 each, 942½ would

		£	s.	d.
	=	942	10	0
@ 10s.	½ (value at £1)	471	5	0
@ 2s. 6d.	¼ (value at 10s.)	117	16	3
		£589	1	3

Compound Multiplication.

a. r. p.
235 2 20
4

942½ r.

£ s. d.
½ 0 12 6×2×942½
10

6 5 4×4
10

62 10 0
9

562 10 0
25 0 0
1 5 0
0 0 3

£589 1 3

SECTION V.

1. A map represents a portion of the earth's surface as seen from *above*. In ordinary maps therefore it is impossible to give correct representations of mountains and valleys, etc.

A picture represents an object, or series of objects, as seen *before* the eye.

To give scholars correct ideas of a map, plans of school, street, town, should be drawn on a flat surface *below* the eye. They will then see that, looking from above, the tables, forms, and desks appear to have no height, and can only be represented by the shape of their tops.

A box of moist sand should then be spread on a white sheet of paper below the level of their eyes. With this, shapes of countries, mountains, valleys, streams and lakes may be made, the paper representing the water, and the sand the land. Looked at from above, the mountains will appear to be without height, the streams will be but crooked lines, and the bays so many indentations in the land.

Practice has shown these methods very valuable in giving children correct ideas of what a map is designed to show.

2. The blackboard and other class apparatus can be used to economise time in teaching sewing, in cutting out, marking, and making different kinds of stitches. Instead of placing patterns before children, and giving garments to be cut from them, a whole class may be set to work at once by drawing a pattern on the blackboard, and writing the dimensions of the garment along the lines. The blackboard may also be used for showing the different kinds of stitches, and the necessity for their regularity and evenness.

Different patterns of Swiss darning, after the fashion of kindergarten work, and letters printed in different colours on different kinds of material, can be placed before a class so as to permit all to see and be engaged on the same kind of work at once.

3. Children lately transferred from an infant school have hitherto been engaged principally in the formation of individual letters, and these are numerous enough to require constant repetition to secure their retention. Combinations have been made from a copy in a teacher's handwriting, written on the blackboard. Another step must now be taken and these combinations must be made from printed characters or from memory. But their knowledge of words is limited; and their knowledge of the signs or letters representing these words is still more limited. Hence it is necessary that the printed characters should be placed before them, in order that they may become perfectly familiar with the written as well as printed characters representing the sounds. Transcription exercises ought therefore to be much more frequently given than dictation, the latter being introduced gradually as the familiarity of the children with words increases. The dictation lessons will be given principally to test the memory, and as a means of judging of the orthography of the children, and the transcription lessons as a means of testing the handwriting.

SECTION VI.

(1) Notes of Lesson on "Glass."

I. WHAT IT IS.—Mixture of sand or flint alkali (soda or potash) and lime (nitre, lead, borax, arsenic, also used for different kinds) made transparent by fusion. (Explain.)

II. HOW MANUFACTURED.—Sand and alkali mixed, burnt in furnace; cleared over a second furnace. Blower takes some out on tube, rolls it, blows it. It is then heated and allowed to cool very gradually (annealing). For plate glass, metal poured on table with raised edges, rolled and annealed.

III. QUALITIES.—(*a*) Transparent, (*b*) smooth, (*c*) brittle, (*d*) fusible.

IV. KINDS.—Flint or crystal glass, plate, crown (best window); broad (coarse window), bottle (commonest).

V. USES.—Windows, ornaments, optical instruments, household requisites; large buildings (Crystal Palace).

VI. PLACE OF MANUFACTURE.—Newcastle-on Tyne, South Shields, St. Helen's, Warrington, Birmingham, Leeds, Berlin, Bohemia.

To train to habits of observation, and to trace the relationship between the qualities of things and the uses to which they are applied.

2. Barometer, common sucker, common pump, diving-bell.

Common Pump.

I. INTRODUCTION.—Necessity for water. How supplied: Tap, rain-barrel, spring, pump.

II. PRINCIPLE.—Illustration: Tumbler placed upside down in water, filled; water remains in tumbler: why? Pressure of atmosphere. Mention barometer. Quicksilver supported at height of 30 inches; water lighter than mercury, supported at height of 33 feet.

III. CONSTRUCTION.—(Draw on blackboard; show model if possible.) Pipe, lower end in water, upper end covered; small door (valve) opening upwards into a box; piston (explain) in which is another valve; moved up and down by handle; spout above piston.

IV. METHOD OF ACTION.—Piston airtight; when raised, air above lifted out; air below raises lower valve to fill its place; piston moves down, upper valve opens, and on again being raised more air removed till ultimately water is raised and flows out of spout. Explain failure of action in summer. Valves shrink, expand on being soaked in water.

V. USE.—To raise water for various purposes; to fill traction engines, etc.

(3a) Lady Jane Grey.

(*a*) Modesty; (*b*) learning; (*c*) piety.

(*a*) When told of the death of Edward, and that she had been proclaimed Queen, she fainted, and on her recovery expressed the greatest reluctance to occupy a place for which, *she* said, she was unqualified by nature and education.

(*b*) Roger Ascham, the schoolmaster, once paid a visit to her house and found her reading *Plato*, while all the rest of the family were hunting in the park. Two lines of Latin poetry were found scratched on the walls of her prison after her execution.

(*c*) When her husband wished to see her on the day of their execution, she refused, fearing it would unnerve them for their death, saying their separation would only be for a few moments, and they would soon meet where death, disappointment, and misfortunes would never mar their felicity.

Fuller says: 'She had the birth of a princess, the learning of a divine, the innocency of childhood, the life of a saint, and yet suffered the death of a malefactor for the offences of her parents.'

(b) Robert Bruce.

Bravery and patriotism; courage under difficulties; devotion.

BRAVERY AND PATRIOTISM.—When Edward seemed to have thoroughly succeeded in conquering Scotland, and Bruce's country seemed to have no friend, the love he had for it roused all his energies. Although repeatedly compelled to flee from

his enemies, in the Battle of Bannockburn he succeeded in almost completely destroying the power of Edward. In this he was always in the thickest of the fight, and the first knight killed in the English army was killed by him.

COURAGE UNDER DIFFICULTIES.—After repeated failures, he hid in the island of Arran. Although almost despairing he was encouraged by the success of the spider in reaching its home. Deceived by a false signal, he nevertheless attacked the castle of Temberry, and took it, this being the beginning of his successes against the English.

DEVOTION.—Before commencing the Battle of Bannockburn he himself set the example to his soldiers of kneeling in prayer and asking for aid for his countrymen.

When he was dying, he desired one of his knights to promise to convey his heart to the Holy Land, in confirmation of his desire to fulfil a vow he had made should he be able to secure peace for his kingdom.

(c) Nelson.

Bravery; honour; patriotism.

BRAVERY.—As a *child*, wandered from grandmother's house after birds' nests; when found, and asked if he were not afraid, said: 'Fear never came near me.'

As a *boy at school*, succeeded in getting pears from a tree in a dangerous position, and said: '*I only got them because every other boy was afraid.*'

As a *midshipman*, went to catch a bear with a shipmate. When his gun missed fire, although in imminent danger of losing his life, he said: 'Never mind; only let me get a blow at him with the butt end, and we shall have him.'

HONOUR.—His brother William and he were sent to school. William was anxious to stay at home, and reported that the snow was too deep. 'Make another attempt,' said the father, 'and if you cannot get there, come back; but remember, I leave it to your honour.' Difficulties presented themselves, and William cited these as excuses for returning home; but Horatio was proof against them all, exclaiming: 'We have no excuse; remember, it was left to our honour.'

PATRIOTISM.—All Nelson's subsequent career was an illustration of the above qualities and his love of his country.

After the sieges of Calvi and Basti, in 1793, although he had been engaged four months, displaying splendid military talents, his services went unrewarded; and although he felt justice had not been done to him, he continued to place his services at the disposal of his country, gaining afterwards numerous victories for her in different parts of the world.

SECTION VII.

(1) *Daily.*—As soon as the children are dismissed, open all the windows, strew slightly-damped sawdust upon the floor, and sweep thoroughly. When the dust caused by sweeping has had time to settle, dust properly all furniture and apparatus.

In winter-time, clear away all ashes, brush the grate or stove, lay fire for following morning, and wash the hearth in addition to above.

Weekly.—Before commencing to sweep use wall-brush to take away cobwebs and dust accumulated during the week, and wash windows outside and inside. The floor should also be washed at regular intervals—in some cases every week; in others, every fortnight or three weeks would suffice.

At longer intervals (during the Midsummer holidays is a convenient time) the walls should be whitewashed, or if painted, washed; the woodwork should be cleaned, and if necessary, varnished or painted; the desks also, and all the apparatus, such as blackboards, easels, etc., thoroughly cleaned. The painting should be renewed as required, at longer or shorter intervals, according to the nature of the district in which the school is situated.

(2) Young children are naturally more restless than those who are older. It is therefore more difficult to retain their attention, unless each individual has continuously something to do. In all lessons, therefore, where much individual practice without imitation is essential, the classes should be smaller than in schools containing older children, in order that each may the oftener be employed. Reading and arithmetic lessons are of this character. Sewing also, and kinder-garten work can only be taught to individuals or small classes. On the other hand, writing, singing, object lessons, and marching can be taught to large numbers, the attention of the children being concentrated principally upon the teacher's words and actions.

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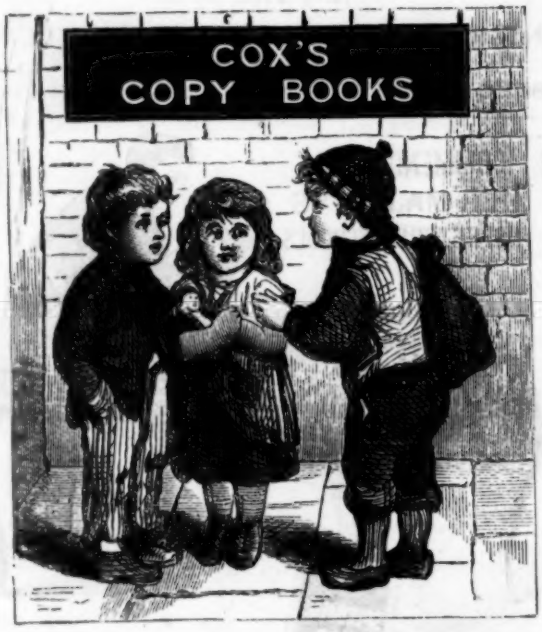

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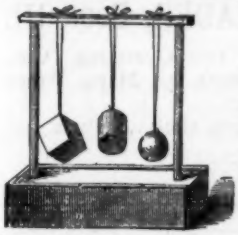

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